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SOME NEW AND REVIVED SUBSPECIES OF RATTLESNAKES

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INTRODUCTION

For the past several years I have been engaged in writing a paper on the habits and life histories of the rattlesnakes. While the proposed paper will not involve a taxonomic study of these snakes, I do hope to include a key and nomenclatorial summary; and in order that the larger work may contain the most recent views respecting the subspecies to be recognized, I think it advisable to publish, first, some conclusions entailing the further subdivision of several hitherto valid forms into additional subspecies, some of which are island races.

A SUBDIVISION OF THE PACIFIC RATTLESNAKE

For some time the Pacific Rattlesnake, *Crotalus viridis oreganus*, has been considered a single subspecies, ranging along the Pacific slope from southern British Columbia into northern Baja California, with an isolated population inhabiting the mountains of central Arizona. I am of the opinion that there would be a practical advantage, facilitating reports and discussions, if further nomenclatorial subdivisions were made in this widespread subspecies, and that such a segregation is warranted by consistent regional differences. No new names are required except for an island form, it being only necessary to retrieve from synonymy some of the names hitherto proposed. The subspecies of the northern Pacific Coast, from south-central California northward, will continue to be known as *Crotalus viridis oreganus* Holbrook, 1840; the southern California and Baja California population will become *C. v. helleri* Meek, 1905; and the Arizona subspecies will be *C. v. cerberus* (Coues), 1875. With regard to the segregation of these populations, it may be said that differences in pattern separate the first pair. When from their centers of distribution—say central Washington and San Diego County, California—it is possible to make allocations that will prove accurate in better than 98 per cent of the individuals, employing the width and color of the posterior tail rings as distinguishing criteria. But the zone of intergradation (and therefore of uncertainty) between the two, in south-central California, is fairly broad, especially in the Coast Range. Also, the differences in the life zones inhabited by these snakes have led to the formation of local varieties, which, while not justifying nomenclatorial recognition, are sufficiently divergent to lead to some confusion and overlapping in defining each subspecies as a whole.

The differences between *helleri* and *cerberus* are based somewhat less on pattern and color, and to a greater extent on average differences in head scales, especially the loreals and the contacts between the first supralabials and the prenasals. In this case there is no intergrading, for the ranges of these

two subspecies, at their nearest points, are separated by 200 miles of desert, uninhabitable to them; however, there is some overlapping of the characters used in segregation, and only a subspecific differentiation is warranted, despite the impossibility of territorial intergradation.

The differences between *oreganus* and *helleri* are probably as important and consistent as those between either and other subspecies of *Crotalus viridis*, such as *lutosus* and *viridis*. The *helleri-cerberus* differences are somewhat less consistent, but in this case we have the added weight of a complete territorial separation.

To indicate the similarity of the three subspecies in scale-counts and pattern, I have set forth in Table 1 the statistics of three example populations: a series of 615 specimens of *oreganus* from near Pateros, Okanogan County, Washington; 645 of *helleri* from the vicinity of San Diego, California; and 97 of *cerberus* from Arizona. Unfortunately, I have no large series of the latter from a single locality, so that the last series involves some regional variability. Altogether, of the forms previously considered to comprise the single Pacific rattlesnake subspecies *C. v. oreganus*, over 2000 specimens have been available for this study.

In Table 1, it will be observed that there are no important subspecific divergences in these primary characters. The differences are relatively greatest between the *helleri* and *cerberus* tail rings, the coefficients of divergence being, for the males, 34.5 per cent, and for the females 33.8. Actually, however, these differences are of little practical interest, as the tail rings of these subspecies are often too ill-defined to permit accurate counting.

TABLE 1

Comparison of Example Series of Rattlesnakes: Mean Scale and Blotch Counts

Character	Pateros *oreganus*	San Diego Co. *helleri*	Arizona *cerberus*
Scale rows	25.51	25.45	25.12
Ventral scutes, males	173.31	173.24	171.23
females	177.98	177.97	175.41
Subcaudal scutes, males	22.99	24.00	23.58
females	18.84	19.44	19.07
Supralabials	15.22	15.17	15.47
Infralabials	16.18	16.03	16.03
Body blotches, males	33.20	34.84	35.24
females	33.19	35.39	35.71
Tail rings, males	5.50	4.27	6.05
females	4.47	3.29	4.63

The coefficients of sexual divergence (the difference between the means of each sex, divided by half their sums, expressed as a percentage), are as follows:

Character	Pateros *oreganus*	San Diego Co. *helleri*	Arizona *cerberus*
Ventral scutes*	−2.7	−2.7	−2.4
Subcaudal scutes	19.8	21.0	21.1
Body blotches*	0.0	−1.6	−1.3
Tail rings	20.6	25.9	26.6

It will be observed that these sexual differences are quantitatively consistent throughout the subspecies. The sexual dimorphism in body blotches is found to be negligible, and therefore no sexual segregation will be made in this character in the subsequent discussion.

Since these three subspecies have not hitherto been segregated in published accounts, I present the following descriptions of the forms as newly delimited:

Crotalus viridis oreganus Holbrook

NORTHERN PACIFIC RATTLESNAKE†

Plate 4, fig. 1.

(Alternative names: Pacific Rattlesnake, Oregon Rattlesnake, Northwestern Rattlesnake).

1840. *Crotalus oreganus* Holbrook, North American Herpetology, ed. 1, vol. 4, p. 115. Type locality: Banks of the Oregon or Columbia River [probably between Walla Walla, Wash., and the Pacific Coast]. Type specimen ANSP 7158.

1842. *Crotalus oregonus* Holbrook, North American Herpetology, ed. 2, vol. 3, p. 21.

1852. *Crotalus lucifer* Baird and Girard, Proc. Acad. Nat. Sci. Phila., vol. 6, p. 177. Type locality: Oregon and California. Type specimen: USNM 7762 (Oregon).

1859. *Crotalus lecontei* (part) Hallowell (not of Hallowell, 1852), Pac. RR. Surv. (Williamson route), vol. 10, pt. 4, no. 1, p. 18.

1860. *Caudisona lucifer* Cope, in Mitchell, Smithsonian Cont. Knowl., vol 12, art. 6, p. 121.

1868. *Crotalus Hallowelli* Cooper, in Cronise, Nat. Wealth Calif., p. 483 (*nomen nudum*).

*Negative values indicate that the female means are higher than the male.

† Among the vernacular names used locally are diamond-back rattler, black diamond, timber rattler, mountain rattler, green timber rattler, green rattler, and gray rattler. The belief is quite general throughout its range that there are two separate species—a lighter, slimmer, lowland form, and a darker, heavier, and more pugnacious mountain species. In many areas the young are called sidewinders, while in others only the lighter, lowland specimens are referred to as sidewinders. However, this subspecies only approaches (but does not overlap) the range of the true sidewinder, *Crotalus cerastes cerastes*, at the southeastern foot of the Tehachapi Mountains.

1883. *Crotalus oregonus* var. *oregonus* Garman, Mem. Mus. Comp. Zoöl., vol. 8, no. 3, p. 173.
1883. *Crotalus oregonus* var. *lucifer* (part) Garman, Mem. Mus. Comp. Zoöl., vol. 8, no. 3, p. 173.
1883. *Crotalus confluentus lucifer* Cope, Proc. Acad. Nat. Sci. Phila., vol. 35, p. 11.
1896. *Crotalus confluentus* (part) Boulenger, Cat. Snakes British Mus., vol. 3, p. 576.
1929. *Crotalus confluentus oreganus* (part) do Amaral, Bull. Antivenin Inst. Amer., vol. 2, no. 4, p. 92.
1936. *Crotalus viridis oreganus* (part) Klauber, Trans. San Diego Soc. Nat. Hist., vol. 8, no. 20, p. 191.

Diagnosis.—This subspecies is characterized in most areas by a generally lighter color than *helleri* or *cerberus;* and by hexagonal or circular blotches, compared with the diamonds prevalent farther south. It has more sharply outlined head marks and lateral secondary blotches. The dark tail rings are of uniform width and are clearly defined, whereas in the other two subspecies the last dark ring is about twice as wide as the others and is ill-defined. In *oreganus,* especially the juveniles, the terminal tail ring is usually darker than those that precede it, and the matrix of the rattle button is generally black; in *helleri* and most specimens of *cerberus* the terminal tail ring in the juveniles is yellow and so is the button. The rattles are of smaller average dimensions in *oreganus* than in *helleri.* From *viridis viridis* and *nuntius, oreganus* differs in having a wider postocular light stripe and fewer tail rings. It is not vermilion or orange in color like *abyssus,* and has less widely separated body blotches than *lutosus.* It is larger and darker than *decolor.*

Nomenclatorial and Systematic Problems.—For about forty years (1860-1898) the rattlesnakes of the Pacific Coast were referred to the species *lucifer* Baird and Girard, 1852. However, in 1898 (p. 141) Van Denburgh had an opportunity to examine the type of Holbrook's *oreganus,* 1840, and correctly determined that this name must supersede *lucifer.* Garman had deduced the close relationship between the two as early as 1883 (p. 173); and in the same year Cope (p. 11) became convinced of the subspecific relationship between the prairie and Pacific rattlers, as subsequently verified by do Amaral (1929, p. 92) and the writer (1930a, p. 123).

Gill (1903, p. 910) called attention to the previously overlooked fourth volume of the first edition (1836-1840) of Holbrook's North American Herpetology, in which the name of this snake is spelled *oreganus,* instead of *oregonus* as in the second edition of 1842. Holbrook's work has been further discussed by Schmidt and Davis (1941, p. 12) and by Schmidt (1942, p. 53). It is evident that Holbrook was dissatisfied with the imperfections of the first edition of his work and sanctioned the destruction of most of the copies. It may be presumed, from the correction that Holbrook himself made, that the *oreganus* of the first edition is a *lapsus calami* and ought to be changed to the *oregonus* of the second, in accordance with Art. 19 of the International

Rules. However, since *oreganus* has been used almost universally during the past quarter of a century, and as a proposal to modify the rules in cases such as this has recently been discussed,* I deem it inadvisable to make the change at this time.

Redescription of the Type Specimen.—The type specimen is Acad. Nat. Sci. Phila. 7158 (old number 840). It is a juvenile male, badly dried and with the surface skin flaked away. No scale counts can be made with complete assurance of accuracy. There are 25 scale rows at mid-body, about 175 ventrals, and 24 subcaudals. The supralabials are 16—16, and infralabials 15—15; the first infralabials are undivided. The scales contacting the rostral probably number 9 and the scales around the canthus 8. There are probably 4, but may be 3 internasals; the canthals are 2—3. There are about 20 scales on the top of the snout anterior to the supraoculars, and the minimum bridge between is 4+5. There may be a row of small scales between the prenasal and the first supralabial on the right only. The nasals are 2—2 and the loreals 1—1. The postnasals contact the upper preoculars, which are undivided. There are no intergenials or submentals. The rostral is higher than wide. The length over-all is about 337 mm., and the tail length 20 mm. The rattle retains only a single ring, which is badly shrunken.

The body blotches number 32 and the tail rings 3 or 4, all of which are black. While the marks are still to be seen, it is impossible to determine what the dorsal color once was; at present it is a light bluish-gray, with black lines between scales. It was probably heavily mottled below. The postocular light stripe is two scales wide. Holbrook's figure shows a pattern of irregular dark-edged hexagons on a gray-green ground color.

The specimen contains mammal hair.

Material.—This study of the subspecies *oreganus,* as newly defined, is based on the scale counts of 1038 specimens, of which 559 were males, 450 females, and the rest indeterminate. Pattern notes were made on about 150 additional specimens. Because of the large series from near Pateros, Washington,—326 males, 289 females, 615 total—the numerical statistics contained in the description that follows have a northern complexion. I have seen well over 1000 rattlesnakes of this subspecies alive.

Description of Subspecies.—This is a snake of the usual *viridis* habitus. Like the other *viridis* subspecies, it differs from all other rattlesnakes in usually having more than 2 internasals; out of 998 specimens only 13.4 per cent had less than three internasals.

The longest specimen of the series I have studied was a female measuring 1320 mm.; a male of proportionate size would be about 1550 mm. Without doubt 5-foot specimens occur occasionally in some areas. The shortest specimen measured was 221 mm., but specimens under 250 mm. are unusual. It is believed that in most areas the young average about 270 mm. at birth.

* R. E. Blackwelder, J. B. Knight, and C. W. Sabrosky, Science, vol. 106, no 2753, pp. 315-6, Oct. 3, 1947; vol. 108, no. 2793, pp. 37-38, July 9, 1948. Wichterman, Science, vol. 106, no. 2760, p. 491, Nov. 21, 1947.

In this subspecies individuals having 25 scale rows at mid-body predominate, the distribution in per cent (in parentheses) of those examined being 23(1), 24(1), 25(71), 26(7), 27(20), 28(*), and 29(*). The mean scale rows number 25.44, the coefficient of variation being 3.5 per cent. Specimens having even scale rows at mid-body comprise 7.9 per cent of the total.

The ventrals in the males vary from 161 to 190, although most specimens fall between 168 and 182. The interquartile range is 170.9 to 176.6, the mean 173.72, and the coefficient of variation 2.4 per cent. The ventrals in the females vary from 167 to 194, although most specimens fall between 170 and 189. The interquartile range is 175.4 to 181.1, the mean 178.24, and the coefficient of variation 2.4 per cent. The subcaudals in the males vary from 18 to 29, but most specimens have from 20 to 27; the interquartile range is 22.3 to 24.6, the mean 23.42, and the coefficient of variation 7.2 per cent. The females range from 15 to 24, although few have less than 16 or more than 22; the interquartile range is 17.9 to 20.0, and the mean 18.95, with a coefficient of variation of 8.1 per cent.

The rostral is higher than wide. There are from 1 to 7 internasals, most specimens having 4 (59 per cent), or 3 (20 per cent). Thirteen per cent have 2, and one per cent 1, and would thus fail to key out as belonging to a *viridis* subspecies. The canthals are usually 3—3, but may be 2—2 or 4—4. The scales on the snout, anterior to the supraoculars, range from 10 to 46, the mean being 24.3, and the coefficient of variation 23.0 per cent. These scales cannot be counted with accuracy in this or any other *viridis* subspecies since there is no well defined line across the anterior edge of the supraoculars such as characterizes *C. scutulatus*, *C. molossus*, and certain other forms of rattlesnakes. The minimum scales bridging the gap between supraoculars vary from 2 to 9, most specimens having 6 (33 per cent), 5 (30 per cent), or 4 (17 per cent). The loreals most often number 2 (54 per cent), or 1 (45 per cent); rarely there are 3, 4, or more. The rostral, first supralabial, and prenasal meet at a point in 80 per cent of the specimens; in 6 per cent there is a group of small extra scales at this point; and in the other 17 per cent these scales are carried back far enough to separate completely the prenasals from the supralabials.

The supralabials range from 11 to 18, but most specimens have from 13 to 17; the interquartile range is from 14.5 to 15.7, the mean 15.08, and the coefficient of variation 5.8 per cent. The most prevalent counts are 15 (48 per cent), 16 (24 per cent), or 14 (20 per cent). The infralabials range from 13 to 20, with an interquartile range of 15.4 to 16.7, a mean of 16.08, and a coefficient of variation of 5.9 per cent. The most frequent counts are 16 (41 per cent), 17 (27 per cent), or 15 (23 per cent). The first infralabials are undivided, and there are normally neither intergenials nor submentals. Usually 3 or 4 infralabials contact the mentals .

The body blotches range from 20 to 41, although most specimens have from 26 to 39. The interquartile range is 31.3 to 34.8, the mean 33.05,

* Present, but less than one per cent. One freak specimen has 33 scale rows.

and the coefficient of variation 7.8 per cent. The tail rings of the males range from 3 to 10, but nearly all fall between 4 and 7, with a mean of 5.61. The females range from 3 to 8, although only one specimen has 8 and only 4 have 7. The mean is 4.50.

The following pattern description is based on this subspecies as it occurs in the vicinity of the type locality in eastern Washington.

In the juveniles the head is brown on top, somewhat mottled with gray posteriorly. There are two light cross-marks, the first just posterior to the upper edges of the postnasals, the other crossing the supraoculars and the frontal area between. On the sides there is a broad dark stripe from the eye to a point above the commissure. Below this, the side of the head, including the supralabials, is light, except that there are aggregations of brown dots from the prenasal, backward and downward, past the pit, to the labials below the eye. Above, the ocular dark streak is bordered by a light line two scales wide that begins at the upper corner of the eye.

The lower jaw is mostly clear, but the mental and first infralabials are punctated with brown. There is usually a clump of dots on the fourth and fifth infralabials, and another group on the fourth and fifth anterior to the commissure.

In the adult snakes the light cross-lines disappear, the head becoming uniformly brown or olive on top. The upper postocular light stripe also tends to disappear, so that the postocular dark streak merges with the dark color of the upper surface. The side of the head below the postocular dark streak remains light, although considerably punctated anteriorly about the nasals and the pit. The dark postocular streak terminates rather abruptly above the commissure, and there is usually, at the angle of the jaw, a white patch that encroaches onto the top of the head. This, together with the light area anteriorly, gives a characteristic "white-faced" appearance to the snakes of this subspecies in many areas. It is, for example, conspicuous in the adult snakes of the Coast Range of northwestern California, being accentuated in the largest adults.

The body pattern in the juveniles comprises a series of brown dorsal blotches about 11 scale rows in width, separated by light interspaces 1 to 2 scales long. The blotches are darkest at their edges, and also the light areas surrounding them are lightest where they border the blotches. The blotches may be round, square, or hexagonal. Laterally, between each pair of dorsal blotches, there is a slightly darkened area of the ground color, but not dark or definite enough to be considered a subsidiary series of spots. Below these, there are two series (the lower smaller than the one above) of dark auxiliary spots; these are, in fact, darker than the dorsal series. The lowest of these lateral spots mark the outer edge of the ventrals. Between blotches, the lateral areas are buff or clay-color, punctated with brown. The ventrum is cream, buff, or yellow, punctated or mottled with gray or brown, especially posteriorly. The dorsal and lateral blotches merge posteriorly to become cross-bars, and the tail is also crossed or ringed by these bars, the last being

the darkest of the series. The last tail ring is no wider than those that precede it. The button matrix is dark, at least anteriorly.

In the adult snakes the lateral secondary spots merge into the ground color, especially anteriorly, so that the lateral areas become almost uniform gray, often with a greenish tinge. The lack of lateral blotches makes the dorsal series the more conspicuous; they are usually brown, and may be round, square, or hexagonal. The light line of scales that edges the dark blotches in the juveniles tends to disappear laterally in the adults. To this extent the snakes of this area resemble *cerberus* rather than *helleri*. Posteriorly, the blotches become darker (dark-brown or even black) and join the lateral series to become cross-bars, or even complete rings. The interspaces are lighter caudad, so that these posterior rings are clearly and definitely outlined, giving a black-and-white effect not evident anteriorly. The last ring is no wider than its fellows, and is, in fact, often narrower, thus differing from *helleri*. The matrix of the proximal rattle is usually black. The ventrum is heavily mottled or punctated with dark-gray, brown, or black, especially toward the tail.

Intrasubspecific Trends.—In this subspecies the snakes having the lowest ventral scale counts are to be found in the vicinity of San Francisco Bay, and those with the highest in the central Sierra Nevada; the difference between the areas is about 12 scales in either sex, the average coefficient of divergence being 7 per cent, which is quite material for an intrasubspecific difference. The snakes of other areas have ventral counts that fall between these two extremes. Specimens from California more often have a single loreal than two, while the reverse is true in Oregon and Washington; also the scales between the supraoculars average lower in California than in the more northerly snakes.

While *oreganus* is quite variable in pattern and color, there are several local phases that are rather consistent and worthy of mention.

Along the northwestern coast of California there is a white-faced variety that is quite distinctive. Probably the center of this phase, where the most conspicuous representatives are found, includes northeastern Sonoma, Lake, and western Colusa counties. In these snakes the area below the dark diagonal line that crosses the eye is unmarked, whereas, in specimens from most other areas, this space on the side of the head is grayish.* Also, there is an expanded light patch posterior to the angle of the mouth, which even encroaches on the normally dark area on top of the head. The dark ocular streak in these snakes merges uninterruptedly with the dark fronto-parietal area, whereas, in most populations of *oreganus*, there is usually a light streak between. This white-faced effect is not evident in the juveniles, but comes on gradually with age. It is usually present in the snakes of Oregon and Washington, but not to so conspicuous a degree as in northwestern California.

Another color phase is to be found at the south end of the San Joaquin Valley, particularly along the more arid west side. Here the snakes are

* This darkening is particularly evident near the pit, below the light streak that comprises the lower border of the dark ocular stripe.

considerably lighter than elsewhere, the ground color being yellowish or tan, and the blotches brown. There is a brown patch on top of the head, with ill-defined outlines. In both color and pattern these snakes are reminiscent of *lutosus*. They merge with the more normally paterned *oreganus* in the foothills or mountains bordering the valley.

In the Marysville Buttes, Sutter County, there is a phase that is markedly green in color, and white-faced as well. The tail rings, however, are sharply contrasting black and white.

I have heard of a red phase occurring in the Trinity Mountains, but have not seen any that answered this description, although some of the snakes of that area have large red-brown dorsal blotches. In the southern Sierra Nevada the specimens from the higher altitudes are darker than those from the foothills; the dorsal blotches are black, just as is the case with *helleri* in the mountains of southern California. An altitude of at least 11,000 feet is reached by *oreganus* in Fresno and the adjacent counties of the southern Sierra Nevada.

Intersubspecific Relationships and Areas of Intergradation.—*C. v. oreganus* intergrades with three of the other *viridis* subspecies—*viridis viridis*, *lutosus*, and *helleri*. All of these are much alike in scale counts and scale arrangements, the differences in squamation between them being no greater than some of the differences found to exist between certain of the local population segments that comprise each subspecies as an entity. The dependable subspecific differences are largely matters of pattern, such as the narrow postocular light stripe and numerous tail rings that characterize *viridis;* the drab ground color, short dorsal blotches, and obsolescent lateral spots of *lutosus*; the larger and darker blotches of *oreganus*, and its wider postocular light stripe (compared to *viridis*); and the wide posterior tail ring of *helleri*.

From these criteria it is evident that *oreganus* is intermediate between *lutosus* and *helleri*. While the northeastern specimens show some slight effect from the direct *viridis* contact, the *oreganus-viridis* relationship is not as close as that of *oreganus* with *lutosus*. *C. v. helleri* was probably derived from *oreganus*, although it may represent an independent invader from an ancestral form in southern Arizona, with a subsequent meeting and re-amalgamation in the central California area where *oreganus* and *helleri* now intergrade.

The direct contact between *oreganus* and *viridis viridis* is a rather tenuous one, the only certain connection being along the Salmon River in central Idaho. The subspecies *viridis* is found in the Lemhi Valley, but in a phase already somewhat modified from the more typical *viridis* of the main body across the Continental Divide in extreme western Montana. As we pass down the Lemhi and Salmon rivers, along which rattlers occur, there is noted a gradual change from *viridis* to *oreganus*, until, eventually, quite typical *oreganus* is encountered in the vicinity of Florence and Riggins, Idaho County, Idaho. There may be a similar connection down the Selway River. The forest rangers of that area agree that the rattlesnakes are largely restricted to the water courses.

The band of intergradation between *oreganus* and *lutosus* is a much broader one. It begins in western Idaho near Council and Payette, and runs westerly through eastern Oregon, past Malheur Lake to the Cascades. Thence it turns south along the crest of the Cascades to the California line, and from there southeastward following the crest of the Sierra Nevada. Along this boundary, where the mountain passes are low, there is intergradation; where the barriers are high there is none. The broadest contacts are probably to be found in western Modoc and Lassen counties, California. At any rate, the continuing subspecific relationship of *oreganus* with *lutosus* is established by the presence of intergrades at a number of localities along this boundary, such as Council, Adams County, Idaho; between Pleasant Valley and Durkee, Baker County, Owyhee, Malheur County, Camp Harney and Princeton, Harney County, and Summer Lake, Deschutes County, Oregon; and Alturas, Modoc County, California. It should be understood that these localities are not to be taken as establishing a sharp line between the subspecies; rather, they are localities from which intergrades have been noted, but they represent only a few points in a broad band of intergradation and may lie near either the *oreganus* or *lutosus* edge of this band.

Whether *oreganus* filters through any of the mountain passes south of Lassen County, California, to intergrade with *lutosus,* I do not know. This could occur as far south as Mono County, for *lutosus,* in typical form, is common in the foothills west of Mono Lake. Rattlers are said to be absent from the vicinity of Lake Tahoe, but I have records that indicate the continued presence of a few specimens in that vicinity, and I suspect that intergradation may occur northwest of the lake, and also to the south. One small specimen in the collection of the University of California (MVZ 17022), from 6 miles north of Fernley, Washoe County, Nevada, has a pattern somewhat more like *oreganus* than *lutosus;* however, this is far into *lutosus* territory and, in the absence of others showing this peculiarity, is to be deemed only a non-modal *lutosus.*

To determine the areas of intergradation between *oreganus* and *helleri,* it is necessary to restate the differences and note that there are several sequences by which one may be transformed into the other. At all ages *oreganus* has uniformly dark and narrow terminal tail rings, and the anterior lobe of the rattle matrix is black. In *helleri* the last tail ring is about twice as wide as the rings that precede it, from which one may deduce that it really comprises two rings fused together, as, indeed, is verified by a study of intergrades. In addition, this wide terminal ring is bright-yellow when the snakes are young, turning to gray, or even black, as they age. The same color change affects the anterior lobe of the rattle matrix. In general, in *oreganus* the final tail rings are darker than those that precede them, while in *helleri* the final ring, at least, is lighter.

In a Sierran area of intergradation, particularly in Kern County but also to some extent in Fresno County, the intergrades, when juvenile, have dark terminal rings and rattle matrices—in color they are *oreganus.* But there is a tendency here toward a narrowing of the light space between the last two

tail rings, this light space being invaded by dark punctations, particularly on the dorsum. As the snakes age, this separating light ring is further narrowed and obscured by the dark adjacent rings, with the result that a snake, which as a juvenile was clearly *oreganus*, might, as an adult, be allocated to *helleri*. Specimens showing this tendency, particularly the partial obliteration of the final light interspace, became increasingly evident from Madera County southward, although they are hardly an appreciable part of the population until at least as far south as Kern County. I have examined 37 specimens from various points in Kern County and found that only 4, whether from the mountain areas or the floor of the San Joaquin Valley, were nearer *helleri* than *oreganus*. The Antelope Valley, a westerly extension of the Mohave Desert, forms a wedge in the *oreganus-helleri* range, for neither form is found on the floor of the desert. Since almost pure *oreganus* inhabits the Tehachapi Mountains to the northwest of this valley, and pure *helleri* the San Gabriel Mountains to the southwest, it is logical to expect intergradation at the point where these mountains meet, that is, in the vicinity of Fort Tejon and Lebec in extreme southern Kern County, and this is found to be the case. This, then, may be taken as a starting point of the boundary between the subspecies.

In the Coast Range, the *helleri* influence is important much farther north than in the Sierra Nevada. This is especially true in the ranges bordering the Pacific—that is, the Santa Cruz and Santa Lucia mountains. A considerable proportion of the juvenile snakes found in San Mateo, Santa Cruz, and western Santa Clara counties have yellowish tails, although this character is virtually absent on the eastern side of San Francisco Bay and the Santa Clara Valley, in Contra Costa, Alameda, and eastern Santa Clara counties. These northern specimens possessing this *helleri* character usually have the yellow tail bar split transversely by a white ring, with the result that they would key out as *oreganus* when adult, after the yellow has turned to gray or black, and would, in fact, as juveniles also, if the width of the last ring were given precedence over the color of the last two.

Tabulating the available material (48 specimens), I find that, while some specimens from San Mateo, Santa Cruz, and Santa Clara counties will key out as *helleri*, especially the juveniles, the majority are *oreganus*, and I therefore assign these areas to the latter subspecies. From Monterey and San Luis Obispo counties I have had an insufficient number of specimens (18) to draw any final conclusions. Probably these represent areas of a fairly even balance between the forms. The specimens from along the edge of the San Joaquin Valley are usually *oreganus*, and those that I have seen from Santa Barbara County were all *helleri*. Tentatively I should fix the approximate boundary between the two subspecies as a line from Lebec, Kern County, via the Carrizo Plain to Shandon, San Luis Obispo County, and thence to the northwestern corner of that county. By such a line I do not, of course, suggest that this really separates the subspecies; rather, it is my intention to indicate that south of this line *helleri* will predominate, and north, *oreganus*.

One might presume, from the stress that I put on the pattern of the tail, that this is a minor difference upon which to justify the segregation of two subspecies. But other differences of pattern are also apparent, although less easily defined and therefore less useful in a key. And, although the tail-band criterion is troublesome in intermediate territory, as is always the case with characters defining intergrading forms, it will correctly segregate practically every specimen from the areas where the subspecies are typical, that is, *oreganus* in northern California, Oregon, Washington, British Columbia, and western Idaho; and *helleri* in southern California and Baja California.

Range.—*C. v. oreganus* ranges along, or close to, the Pacific Coast, from British Columbia to south-central California. It is the only rattlesnake occurring in British Columbia or Washington; and it is the only rattler found throughout the rest of its range—neglecting intergradation with other *viridis* subspecies—although there may be a narrow overlap with *C. mitchellii stephensi* through the Sierra Nevada passes along the southern border between Tulare and Inyo counties, and a similar fringe overlap with *C. s. scutulatus* and *C. c. cerastes* in the desert foothills southeast of the Tehachapi Range in Kern County, California.

In British Columbia, *oreganus* occurs from the line Lillooet-Hat Creek-Kamloops-Shuswap Lake, south to the U. S. border, with an eastward extension just north of the border to Christina Lake and possibly Waneta. I have had no reports of specimens in the vicinity of Yale or Hope, or from these points south or southeast to the border.

In Washington, *oreganus* occurs only to the east of the Cascade Range. Along the Columbia River it has penetrated as far west as Carson, Skamania County. East of the Cascades it seems to range throughout the state; however, it is absent from the extreme northeast; at least I have no records from Pend Oreille County or eastern Spokane County.

In Idaho, *oreganus* ranges along the western border from the southern end of Lake Coeur d'Alene south to near Council and Weiser, in the vicinity of which there is intergradation with *lutosus*. Also, from this westerly fringe there are extensions eastward up the Clearwater and Salmon rivers and their tributaries toward narrow areas of intergradation with *viridis viridis*.

In Oregon, *oreganus* occupies the northern and western sections of the state; the southeast, with the limits that I have discussed under intergradation, being inhabited by *lutosus*. In the northern part of the state, *oreganus* is plentiful on the lower east slopes of the Cascades, and thence eastward across the state, but to the west it is not so prevalent, although scattered through the Willamette Valley, at least from Cottage Grove north to Amity. It is apparently absent between the Willamette Valley and the coast. South of Cottage Grove it is increasingly plentiful in the mountains that lie between the crest of the Cascades and the coast, the unoccupied coastal area gradually narrowing until it almost disappears at the California line.

In California, *oreganus* occurs everywhere west of the Sierra Nevada

and its area of intergradation with *lutosus* through the passes of that range, as discussed elsewhere, and north of its area of intergradation with *helleri*. It is seldom found in the coastal redwood belt from Sonoma County northward through Mendocino, Humboldt, and Del Norte counties; yet an occasional stray, possibly carried seaward by a river flood, is picked up in this section, sometimes within 10 miles or less of the coast. The subspecies, however, seems unable to establish itself permanently in the coastal redwood belt. There are large areas in the state, especially in the Central Valley and the coastal valleys, and about centers of population, where rattlers have now become exterminated; but these were once occupied, as their continued presence in adjacent parks and wildlife refuges demonstrates.

This subspecies occurs on Morro Rock, a small rocky island off the coast of San Luis Obispo County, now connected by an artificial causeway with the mainland. Such specimens as I have seen from the island were apparently stunted.

Crotalus viridis helleri Meek

SOUTHERN PACIFIC RATTLESNAKE*

Plate 4, fig. 2.

1859. *Crotalus lecontei* (part) Hallowell (not of Hallowell, 1852). Pac. RR. Surv. (Williamson route), vol. 10, pt. 4, no. 1, p. 18.
1859. *Crotalus lucifer* Cope, Proc. Acad. Nat. Sci. Phila., vol. 11, p. 337.
1863. *Crotalus adamanteus* var. *lucifer* Jan, Elenco. Sist. degli Ofidi, p. 124.
1870. *Crotalus Hallowelli* Cooper, Proc. Cal. Acad. Sci., vol. 4, part 2, pp. 64, 68 (*nomen nudum*).
1883. *Crotalus confluentus* var. *lucifer* (part) Cope, Proc. Acad. Nat. Sci. Phila., vol. 35, p. 11.
1883. *Crotalus oregonus* var. *lucifer* (part), Garman, Mem. Mus. Comp. Zoöl., vol. 8, no. 3, p. 173.
1898. *Crotalus oregonus* (part) Van Denburgh, Proc. Amer. Philos. Soc., vol. 37, no. 157, p. 141.
1905. *Crotalus helleri* Meek, Field Col. Mus., Zoöl. Ser., vol. 7, no. 1, pub. 104, p. 17. Type locality: San José [Lat. 31° N.], Baja California. Type specimen: CNHM 1272; paratypes: CNHM 1727 (3).
1917. *Crotalus oreganus* (part) Grinnell and Camp, Univ. Calif. Pubs. in Zoöl., vol. 17, no. 10, p. 194.
1929. *Crotalus confluentus oreganus* (part) do Amaral, Bull. Antivenin Inst. Amer., vol. 2, no. 4, p. 92.
1936. *Crotalus viridis oreganus* (part) Klauber, Trans. San Diego Soc. Nat. Hist., vol. 8, no. 20, p. 191.

Diagnosis.—This subspecies usually has diamonds on the back, instead of hexagons as in *oreganus*. The last dark tail ring in the adults is more than

* Has such alternative local names as black diamond-back, gray diamond-back, Pacific rattler, San Diegan rattler, timber rattler, black rattler, and mountain rattler. Young specimens are often referred to as sidewinders.

1½ times as wide as the preceding dark ring, while in *oreganus* the rings are equal. In the juveniles the end of the tail in *helleri* has a wide yellow ring, gradually turning to gray or black as the snakes age; in *oreganus* the terminal cross-band is dark from birth and is no wider than the rings that precede it on the tail. The button matrix is usually yellow in juvenile *helleri* and black in *oreganus*.

C. v. helleri differs from *cerberus* in having a single row of light scales completely bordering the dorsal diamonds, whereas in *cerberus* the dorsal blotches laterally merge directly into the ground color. A majority of specimens of *helleri* have single loreals, while *cerberus* has two. Most *helleri* specimens have no scales between the prenasal and the first supralabial at the rostral; in *cerberus* such scales are generally present, at least at the rostral. The differences from the other *viridis* subspecies are similar to those cited under *oreganus*.

Nomenclatorial and Systematic Problems.—If the subspecies of *Crotalus viridis* found in southern California and Baja California is to be separated from the snakes of the northwest and Arizona, *helleri* Meek, 1905, is the oldest available name, although Meek described it as new only because of his unfamiliarity with the snakes of the San Diegan region; for those of the type locality differ in no important particular from the San Diegan snakes, which were well known (as *C. lucifer*) in 1905. It is to be regretted that the long-used name *lucifer* cannot be revived for the southern race, but although Baird and Girard did not originally specify a type in 1852 (the type locality was given as Oregon and California), and specimens from southern California may have been available to them, they did set up a type, from Oregon, in 1853 (p. 8). *C. lecontei* of Hallowell, 1859, although in part from southern California, is not available, as the original description (Hallowell, 1852) was based on a specimen of *C. v. viridis* from Cross Timbers, in what is now Oklahoma (Stejneger, in do Amaral, 1929, p. 87). *Crotalus hallowelli* of Cooper, 1868, cannot with certainty be assigned to southern California, and besides is a *nomen nudum*. This I have cited under the synonymy of *oreganus*, since he mentions its presence in the Sierras. Cooper's second mention of *hallowelli* (1870, pp. 64, 68) leaves little doubt that he had in mind the Pacific Coast subspecies of *viridis*, since only this snake is present in both the Sierras and the San Diegan region. As the first mention (1868) referred to the Sierran range, it is probable that the name, if valid, would have to be assigned to the northern race, for which it would be preceded by both *oreganus* and *lucifer*. But, in any case, it is a *nomen nudum* for lack of a type specimen, type locality, or any description. This is to be regretted, as Hallowell's distinguished work on the herpetology of the West might well be recognized by associating his name with this snake. Cooper, in his 1870 paper, by the use of the initials Cp. after the name *Crotalus Hallowelli*, indicated that he considered himself the describer. He must have known that neither the mention of the snake in Cronise's book nor in his 1870 paper constituted description, from which one may infer that he actually presented the description in a paper that remained unpublished or that has been overlooked.

Redescription of the Type Specimen.—The type specimen is CNHM (formerly Field Museum) 1272, from San José (Lat. 31° N.), Baja California. Comparing it with specimens from Meling's Ranch at San José, I should say, from its dark color, that it was probably collected on the mountain slope to the east. It is an adult male, with a length over-all of 957 mm., and a tail length of 60 mm. The scale rows at mid-body are 25, ventrals 173, and subcaudals 25. All supra- and infralabials number 15. The rostral is higher than wide; it contacts 8 scales. The internasals number 4 and the canthals 2—3. The minimum scales between the supraoculars are 5+5. There are no small scales touching the rostral between the first supralabials and the prenasals. The junction of the postcanthals and the loreals prevents a contact between the postnasals and the upper preoculars, which are undivided. There are 2 to 3 scale rows between the supralabials and the orbit.

The head is almost black, both the supraocular and postocular light marks being obsolete. There are 32 body diamonds, and 4 rings on the tail, the last being wide and black. The body blotches are quite black anteriorly and somewhat brownish toward the tail; they are outlined by straw-colored single rows of scales.

There are 5 rattles, a broken string.

Material.—The description which follows is based on 892 mainland specimens, of which 645 were from San Diego County. There were 473 males and 399 females, the rest being heads, skins, or otherwise indeterminate. There have been 22 specimens available from Santa Catalina Island. I believe I have seen well over 3000 rattlesnakes of this subspecies alive.

Description of Subspecies.—This is a snake of the usual *viridis* shape. Like other subspecies of *viridis*, it differs from all other rattlesnakes in usually having more than 2 internasals; in 893 specimens, 81, or 9.1 per cent, had 2 internasals or less.

The longest specimen I have measured was 1371 mm. It is thought that fully adult males are usually about 1200 mm. in length. At birth the young specimens normally measure about 275 mm., although occasionally they are as short as 225 mm.

Most specimens of this subspecies have 25 scale rows at mid-body, the distribution in per cent being 23(1), 24(1), 25(71), 26(5), 27(21), 28(*), 29(1). The mean is 25.43 and the coefficient of variation 3.6 per cent.

The ventrals in the males vary from 162 to 184, but all but a very few specimens fall between 166 and 181. The interquartile range is 171.2 to 176.1, the mean 173.67, and the coefficient of variation 2.1 per cent. The ventrals in the females vary from 166 to 189, although most specimens fall between 170 and 187. The interquartile range is 175.7 to 180.7, the mean 178.23, and the coefficient of variation 2.1 per cent. The subcaudals in the males vary from 19 to 29, all but a few specimens falling between 21 and 27; the

* Present, but less than 1 per cent.

interquartile range is 23.0 to 25.1, the mean 24.08, and the coefficient of variation 6.3 per cent. The females range from 15 to 25, with all but a few specimens falling within the range 16 to 23; the interquartile range is 18.3 to 20.5, the mean 19.39 and the coefficient of variation 8.4 per cent.

The rostral is higher than wide. There are from 1 to 8 internasals; most specimens have 4 (73 per cent), 3 (15 per cent), or 2 (9 per cent). The canthals usually number 2 on each side, but are often 3, or rarely 4. The scales on the snout, anterior to the supraoculars, range from 7 to 45, although most specimens fall between 13 and 33. The mean is 23.4 and the coefficient of variation 22.1 per cent. These scales cannot be counted with particular accuracy in this subspecies since there is no well-defined line at the anterior edge of the supraoculars. The minimum scales bridging the gap between the supraoculars vary from 1 to 9, most specimens having 4 (34 per cent), 5 (28 per cent), 6 (17 per cent), or 3 (12 per cent). The loreals most often number 1 (82 per cent), or 2 (18 per cent). An occasional specimen may have 3. In this subspecies, in 69 per cent of the specimens, the prenasal touches the first supralabial at their common point of contact with the rostral; however, in 17 per cent of the specimens there is an extra scale or two at this tripartite junction, and in the other 14 per cent a complete row of small scales separates the prenasal from the initial supralabial.

The supralabials range from 12 to 18; the interquartile range is from 14.8 to 16.1, the mean 15.14, and the coefficient of variation 6.3 per cent. The most prevalent counts are 15 (46 per cent), 16 (26 per cent), or 14 (20 per cent). The infralabials range from 13 to 20, with an interquartile range of 15.3 to 16.6, a mean of 15.96, and a coefficient of variation of 6.1 per cent. The most frequent counts are 16 (41 per cent), 15 (25 per cent), or 17 (24 per cent). The first infralabials are undivided, and neither intergenials nor submentals are usually present.

The body blotches vary from 27 to 43, nearly all specimens falling between 29 and 41. The interquartile range is 33.5 to 36.8, the mean 35.14, and the coefficient of variation 7.0 per cent. The tail rings in the males range from 3 to 8, with a mean of 4.52, and in the females from 2 to 6, with a mean of 3.44.

In the young of this subspecies the colors are sharply contrasting. The head is dark-brown above, with a light mark across the supraoculars and the frontal area. There is often a second thinner line across the head at the posterior ends of the central internasals, and a light longitudinal line joining the two cross-lines. The rostral is usually edged with light, but is otherwise dark-brown. On the side of the head a wide light stripe passes backward and downward, just touching the lower edge of the orbit; it widens at the supralabials, so that these are light from below the center of the eye backward almost to the commissure. Bordering this light streak above, there is a wide dark streak from the eye to the commissure, and this in turn is bordered above by a light streak two scales wide, which starts at the posterior outer edge of the supraocular, and is directed backward and downward to the angle of the jaw. On the underside, the mental and first supralabials are dark, and so

are the genials along their line of contact. The posterior infralabials may all be spotted, or some may be clear. There is often a collection of spots marking the gulars, anterior to the first ventrals. All dark areas on the head are usually chocolate-brown; the light are cream or buff.

As the snakes age, the light head marks gradually disappear, until, in the adults, only the preocular light streak is left and even this is often obscured by punctations. Thus the head becomes uniform dark-brown or black above, and quite dark on the sides. The markings of the lower jaw are little changed with age.

A somewhat similar change takes place in the body marks, the juveniles being clearly marked, while the adults are duller and darker.

In the young the pattern comprises a series of dark-brown blotches, about 9 or 11 scale rows wide, separated by interspaces of buff or light-gray extending over 1½ to 2 scales end-to-end. The blotches are rather irregular, but are usually diamonds or hexagons. They are slightly lighter in the centers than on the edges, and are bordered with light scales, laterally as well as dorsally. On the sides, between blotches, there are brown areas which may be considered a first secondary series, or may be viewed as patches of ground color. Below these there are one or two other series of darker-brown and more evenly edged secondaries. The lowest touch the outer edges of the ventrals, which are mottled or punctated with dark, especially toward the tail, on a buff or yellow background.

Toward the tail the dorsal blotches tend to merge with the secondaries to become dark cross-bands. However, the last tail band, having about twice the width of those that precede it, is bright-yellow in color, and so is the matrix of the button.

As the snakes age the contrast between the light and dark areas is less accentuated, only the light scales that border the dorsal blotches remaining fairly clear, although even these are often darkened at the anterior end of each scale. These light blotch-borders remain in evidence, not only middorsally, but laterally as well; in this respect, this subspecies differs from *cerberus*. The yellow terminal tail ring of the juveniles, so conspicuously different from the rest of the coloration, gradually darkens, beginning at about the time the second rattle is acquired, until, when the snake is fully grown, it is dark-gray or black, and thus does not differ from the preceding rings, except that it retains its double width. In the adults, in some areas, a faint light ring may suggest the beginning of a division of this terminal ring, thus suggesting the relationship with *oreganus*. The blotches in the adults are often black, compared with the dark-brown of the juveniles; and the reduction of the light areas between blotches makes the adults generally darker. This is accentuated in mountain specimens.

This description is based primarily on the snakes of the San Diegan area.

Intrasubspecific Trends.—*C. v. helleri* has a smaller and more uniform range, ecologically speaking, than either *oreganus* or *cerberus;* and, as might

be expected, is more homogeneous. There is a slight tendency toward a higher number of ventral plates and a greater subdivision of the head scales, as one proceeds northward and westward. A similar moderate increase is to be observed in the number of body blotches. Contrasting with those from the lowlands, specimens from the mountains are generally darker, often almost black, thus justifying the popular name, black diamond.

The few individuals available from the desert foothills are decidedly light-colored. One of the two southernmost specimens—that from Playa María Bay, Baja California—has some peculiarities of pattern, particularly in the head marks and the way in which the tail rings are interrupted laterally in a manner reminiscent of *exsul*. It is conspicuously light in color. The other, from northwest of Bahía Angeles on the Gulf coast, is peculiar in having long, narrow blotches on the neck.

Intersubspecific Relationships.—*C. v. helleri* contacts no subspecies of *viridis* other than *oreganus*, intergradation with which has already been discussed. Although *helleri* no longer has a physical contact with *cerberus*, its relationship with that subspecies seems as close as with *oreganus*, since occasional specimens will be found in the territory of either that are quite like the mode in the other. In fact, it is to be noted that *helleri* and *cerberus* are alike in the character that I have used to separate *helleri* from *oreganus*, that is, the width and color of the posterior tail rings. These and other similarities are evidence that there must at one time have been a direct contact of the two populations across the area now occupied by the Colorado and Yuma deserts. *C. v. helleri* is more closely related to *oreganus* and *cerberus* than to any other *viridis* subspecies.

Range.—*C. v. helleri* is found only in southern California and northern Baja California. The area of intergradation with *oreganus* has already been discussed (p. 74). *C. v. helleri* is the sole subspecies of the western rattlesnake, *Crotalus viridis*, occurring in southern California. Neglecting areas of intergradation with *oreganus*, it is found from the north line of Santa Barbara, Ventura, and Los Angeles counties, southward through southwestern San Bernardino, Orange, western Riverside, San Diego, and extreme southwestern Imperial counties, into Baja California, where it occurs as far south as Latitude 29° N. In this area, except where it has been exterminated by the encroachment of cities and intensive agricultural developments, it is quite common from the coast across the mountains. In the desert foothills it becomes increasingly rare as the descent is made to the desert itself, and in the desert it is absent. Altitudinally it ranges from sea level to the peaks of the highest mountains. It has been collected a few feet below the peak of San Jacinto (10,805 ft.), and as only one mountain (San Gorgonio, 11,485 ft.) within the *helleri* range is higher, it may be assumed that altitude is nowhere a serious impediment to its occupancy.

In Baja California it has been taken at a large number of points from the coast to the crest of the Sierra Juárez and Sierra San Pedro Mártir, and as far south as Socorro (Lat. 33° 20′ N.). No specimens are yet available from the desert slopes of these mountains, but no doubt it occurs there spo-

radically, as it does in California. South of Socorro two specimens have been taken; one at Playa María Bay, some 120 miles below Socorro, on the Pacific side; the other, 10 miles northwest of Bahía Angeles on the Gulf of California side, a rather surprising find in such arid surroundings, for it was taken by Lewis W. Walker in desert mountains, amid an elephant-tree association.

C. v. helleri occurs on Santa Catalina Island, Los Angeles County.

Crotalus viridis cerberus (Coues)

ARIZONA BLACK RATTLESNAKE*

Plate 5, fig. 1.

1866. *Caudisona confluenta* var. *confluenta* (part) Cope, Proc. Acad. Nat. Sci. Phila., vol. 18, p. 307.
1866. *Caudisona lucifer* Cope, Proc. Acad. Nat. Sci. Phila., vol. 18, p. 307.
1875. *Crotalus lucifer* (part) Yarrow, Surv. W. of 100th Mer. [Wheeler], p. 529.
1875. *Crotalus confluentus* (part) Yarrow, Surv. W. of 100th Mer. [Wheeler], p. 530.
1875. *Caudisona confluenta* (part) Coues, Surv. W. of 100th Mer. [Wheeler], p. 604.
1875. *Caudisona lucifer* var. *cerberus* Coues, Surv. W. of 100th Mer. [Wheeler], p. 606. Type locality: San Francisco Mountains, Coconino County, Arizona. Type specimens: Field numbers 509 (=ANSP 7085?) and 511 (=ANSP 7088).
1883. *Crotalus lucifer* (part) Yarrow, Bull. U. S. Nat. Mus., no. 24, p. 76.
1883. *Crotalus oregonus* var. *cerberus* Garman, Mem. Mus. Comp. Zoöl., vol. 8, no. 3, p. 173.
1913. *Crotalus oregonus* Van Denburgh and Slevin, Proc. Cal. Acad. Sci., ser. 4, vol. 3, p. 428.
1917. *Crotalus oreganus* (part) Grinnell and Camp, Univ. Calif. Pubs. in Zoöl., vol. 17, no. 10, p. 194.
1930. *Crotalus confluentus oreganus* (part) Klauber, Trans. San Diego Soc. Nat. Hist., vol. 6, no. 3, p. 130†
1936. *Crotalus viridis oreganus* (part) Klauber, Trans. San Diego Soc. Nat. Hist., vol. 8, no. 20, p. 191.

Diagnosis.—Cerberus is a subspecies characterized by its dark color and a marked subdivision of the scales of the snout. It differs from the newly delimited *oreganus* and *helleri*, with which it was formerly merged under the name *oreganus*, in usually having paired loreals (Klauber 1930b, plate 1, fig. 2), while they have single loreals (figs. 1, 3, or 4). Also, most specimens of *cerberus* have one or more scales at the rostral between the anterior nasal and the first supralabial (*loc. cit.*, fig. 6 or 7), while such

* Has the alternative local names of brown rattlesnake, black rattlesnake, black diamond, mountain diamond-back.

† Do Amaral (1929, p. 95) considered the Arizona specimens to be *confluentus* (= *viridis*) × *oreganus* intergrades.

scales are usually absent in *helleri* and *oreganus* (fig. 5). *C. v. cerberus* has a wider terminal dark tail ring than *oreganus*. The dorsal body blotches are without lateral light borders, such as are generally present in *helleri*.

Nomenclatorial and Systematic Problems.—While Coues did not describe his new subspecies, *cerberus*, except to call attention to its black head, he did specify type specimens, so there is no question as to the validity of his name, if segregation from the California forms be justified, as I now believe to be the case.

There is some uncertainty with respect to these types of *cerberus*. Coues had at least six specimens from the San Francisco Mountains and Fort Whipple. Four he assigned to *Caudisona lucifer*. At least one of these must have been *molossus*, judging by his description; of the others, two, ANSP 7086 (original number 510) and ANSP 7087 (original number 572?), are *cerberus*, but were not assigned by Coues to his new subspecies, as they were browner than the types. But it is now known that there is some color variation in the snakes of the type locality.

Coues mentioned only two types by number, although stating that he had others from the type locality. Of these two cotypes, No. 511 is now ANSP 7088, and 509 is believed to be ANSP 7085. Since Coues did not describe his types, no comparisons with his descriptions can be made. The following descriptions are of these two, imperfect as they are.

Redescription of the Type Specimens.—ANSP 7085 is a skin in rather poor condition. It is a male with a length of about 850 mm. The scale rows at mid-body are 27, ventrals 167, subcaudals 26. The supralabials number 17, the internasals 6; there are 14 scales in contact with the rostral. Although the prenasals touch the rostral, they are separated from the first supralabials, as is characteristic of this subspecies. There are two loreals on each side. The intersupraoculars number 7+9.

There are 5 tail rings, all black. The body blotches cannot be counted accurately. They are quite black, and, in fact, the entire dorsal surface is almost black, except for a few straw-colored scales between the blotches, mid-dorsally.

There are six rattles, an incomplete string; the width of the proximal rattle is 15.5 mm.

Of ANSP 7088 only the head and neck remain. The supralabials are 16—15 and infralabials 15—15. There are 9 scales around the rostral, which is higher than wide. There are 5 internasals, which come well down the sides but do not completely separate the rostral from either prenasal. The prenasals are not separated from the anterior supralabials, nor are there extra scales at the rostral-prenasal-supralabial junction. The canthals are 4—4; there are about 45 scales before the supraoculars, and 3+5 scales between. The loreals are paired.

The head is brown, the usual marks being obsolete. The initial dorsal blotches are brown, with dark punctations.

Material.—Of this subspecies 98 specimens have been available for study, one from New Mexico, the rest from Arizona. Several additional specimens with questionable locality data have been omitted from the statistics of the description that follows. Some 50 snakes have been seen alive.

Description of Subspecies.—This is a snake of average *viridis* proportions. Like others of the *viridis* subspecies, it differs from all other rattlesnakes in usually having more than 2 internasals; only 2 per cent of this subspecies have 2 internasals.

The longest specimen of the series I have studied is a male measuring 1032 mm.; the shortest 287 mm. I have a brood that is presumably of this subspecies, but not certainly, as there were several mothers in the cage when they were born. Of this brood of 13, the shortest is 265 mm., the longest 288 mm., and the mean 273 mm.

Most specimens of this subspecies have 25 scale rows at mid-body, the distribution in per cent (in parentheses) being 23(4), 24(6), 25(76), 26(2), 27(12). The mean scale rows are 25.12, the coefficient of variation is 3.4 per cent.

The ventrals in the males vary from 161 to 180, although most specimens fall between 166 and 176. The interquartile range is 168.6 to 173.9, the mean 171.23, and the coefficient of variation 2.3 per cent. The ventrals in the females vary from 164 to 184, although most specimens fall between 171 and 183. The interquartile range is 172.1 to 178.7, the mean 175.41, and the coefficient of variation 2.8 per cent. The subcaudals in the males vary from 20 to 26, interquartile range 22.6 to 24.5, mean 23.58, coefficient of variation 5.9 per cent; the females range from 16 to 24, interquartile range 17.7 to 20.5, mean 19.07, coefficient of variation 10.9 per cent.

The rostral is higher than wide. There are from 2 to 8 internasals; most specimens have 4 (59 per cent), 3 (20 per cent), or 5 (11 per cent). Only two per cent have 2, and would thus fail to key out as a *viridis* subspecies. The canthals are usually 3—3, but are often 2—2 or 4—4. The scales on the snout, anterior to the supraoculars, range from about 20 to 50, the mean being 35, and the coefficient of variation 20.4 per cent. These scales cannot be counted with accuracy in this subspecies since there is no well-defined line at the anterior edge of the supraoculars, thus differing from *C. scutulatus* and certain other forms of rattlesnakes that have definite boundaries between the prefrontal and frontal areas. The minimum scales bridging the gap between the supraoculars vary from 2 to 9, most specimens having 6 (26 per cent), 5 (24 per cent), or 7 (21 per cent). The loreals most often number 2 (65 per cent), followed by 1 (23 per cent), or 3 (9 per cent); the extreme variation is 1 to 6. While the prenasals usually contact the rostral, this contact is prevented by rows of small scales in 17 per cent of the specimens. The percentage having this *mitchellii*-like characteristic is higher than in any other *viridis* subspecies. *Cerberus* is also exceptional in

* This characteristic is evident in some of the diamond-backs, notably the Cedros Island species, *C. exsul,* and to a less extent in *C. r. ruber.* and *C. r. lucasensis.*

another scale arrangement, the presence of a small row of scales interposed between the prenasals and the first supralabials.* This row is complete in 72 per cent of the counts, and in an additional 8 per cent there are one or more extra scales at the junction of the rostral, prenasal, and first supralabials, thus partly interrupting the contact.

The supralabials range from 13 to 18; the interquartile range is from 14.8 to 16.1, the mean 15.47, and the coefficient of variation 6.2 per cent. The most prevalent counts are 15 (44 per cent), 16 (33 per cent), or 17 (10 per cent). The infralabials range from 13 to 19, with an interquartile range of 15.3 to 16.8, a mean of 16.03, and a coefficient of variation of 6.8 per cent. The most frequent counts are 16 (38 per cent), 15 (25 per cent), or 17 (21 per cent). The first infralabials are undivided, and there are neither intergenials nor submentals.

The body blotches vary from 25 to 46, although nearly all specimens fall between 29 and 42. The interquartile range is 32.9 to 37.9, the mean 35.39, and the coefficient of variation 10.3 per cent. The tail rings of the males range from 3 to 9; most fall between 5 and 8, with a mean of 6.05. The females range from 3 to 7, although only one specimen has the latter number; the mean is 4.63.

The head marks in the adults of *cerberus* are virtually obsolete, the heads being usually uniform, or mottled, brown or black. The preoculars are often lighter and occasionally a preocular light streak, to the angle of the mouth, may be faintly seen. A postocular light stripe, while ordinarily obsolete, is sometimes present. These marks are usually faintly evident in the specimens from the Santa Catalina and Rincon mountains, in gray against a black background. The infralabials, mental, and genials are punctated with brown; the lower jaw is otherwise clear buff, although there may be aggregations of brown dots scattered about.

In the juveniles the head marks are not unlike those of the coastal specimens. There are preocular and postocular light streaks sloping downward and backward, separated by a dark ocular stripe. The postocular mark is two scales wide. A light supraocular cross-dash is also present.

The body pattern in the adults consists of a middorsal series of round, elliptical, or hexagonal blotches. These may be brown, red-brown, dark-brown, or black, the edges usually somewhat darker than the centers. The blotches are from 9 to 15 scale rows wide, most often 11 or 13. They are close together, being separated by one to two transverse lines of lighter scales, which range in color from yellow to light-brown. On the sides there are two rows of subsidiary blotches, smaller and less conspicuous than the dorsals, for they are not sharply differentiated from the ground color, which is usually brown, or dark-brown, but may be gray. The light scales which separate the dorsal blotches are clearest and most evident middorsally; laterally these light bordering scales become increasingly clouded, so that, in adult specimens, the blotches on the sides are without the light bordering row, and thus merge directly into the ground color. This is a distinguishing characteristic from *helleri*, in which the light lateral borders of the blotches

are usually evident. In fully adult specimens from the Catalina and Rincon mountains the light separating lines may be reduced to a half-dozen light scales middorsally; these are often bright-yellow in life.

The tail is crossed by brown or dark-brown bars, imperfectly set off by the ill-defined lighter areas between. The last bar is usually about twice as wide as the others, but this may not be true, especially in the northwest area of the range; here the last ring may be no wider, but may be distinctly darker than the others.

The lower surface is buff or yellow, heavily blotched or mottled with gray, brown, or black. This mottling is accentuated posteriorly.

The young specimens are lighter and brighter, with the pattern better defined. The light edges of the dorsal blotches are evident laterally. The secondary spots, especially the lower row, are more contrasting with the ground color. The final tail ring is yellow, or gray with a tinge of yellow, much like the coastal *helleri*.

Intrasubspecific Trends.—There is a considerable pattern and color variation in *cerberus*, particularly in the montane-island groups in the southern part of the range, in the Santa Catalinas, Rincons, and Pinaleños.

Probably the most distinctive are the black rattlers of the Santa Catalina Mountains. When adult these are handsome jet-black snakes, the dorsal blotches being distinguishable only through the presence of small groups of yellow middorsal scales, which represent the obsolescent remnants of the usual light interspaces. These snakes, and, in fact, nearly all *cerberus*, change considerably on preservation, the interspaces and the lateral areas becoming somewhat lighter, so that both the main dorsal series and the auxiliaries on the sides become more evident than in life.* I have found that this same color change may be effected to a lesser extent by increasing the temperature of a live snake; I have seen a specimen under varying conditions, with the dorsal blotches at times much more conspicuous than at others.

In some areas the snakes are dark-brown, rather than black, with large round or oval dorsal blotches, set close together. The sides are lighter-brown.

* The following color notes were made Aug. 2, 1930, in the course of preserving 4 *cerberus*, 2 from Gleed and the others, somewhat larger, from Iron Springs and Hillside, Yavapai County, Arizona: "They vary from quite black with no evident dorsal blotches and only a few light-tipped scales—in the larger specimens—to gray-brown in ground color with dark-brown blotches outlined in punctated buff. The head is almost unicolor, except that the side stripes can be faintly seen in the smaller specimens. After their deaths on the following morning—by drowning in alcohol—the color changes are almost beyond belief, especially in the two larger specimens. The black dorsal blotches have become brown, interspersed with some gray. The lateral ground color has become light-gray. The blotches are now very clearly outlined, whereas before they could be distinguished only when viewed with the light at a particular angle. The yellow scale tips along the dorsum remain unchanged as an evidence of the only light areas that were once apparent, for all else was black before. The ventrums have also become lighter." From these notes it is evident that preserved specimens of this subspecies do not afford an accurate idea of the coloration in life. It explains why *cerberus* is so generally called the "black rattlesnake" in Arizona, whereas preserved specimens are often blotched with brown or gray.

This is true of most specimens of the Skull Valley-Prescott area, although some from here are black. I have seen an occasional specimen with bright-red (not red-brown) on the lower lateral scale rows. This color disappeared completely in preservation.

Toward the northwest the snakes are often grayish. In the San Francisco Peaks they are black or brown.

I have too few specimens to demonstrate any important geographical trends in ventrals, subcaudals, or labials. The Santa Catalina and Rincon mountain snakes have head scales less divided than in those from the center of the range; that is, they have fewer paired loreals, fewer scales in the interupraocular area, and less often have the prenasals separated, or partly separated, from the first supralabials. All of these divisions are characteristic of *cerberus* as compared with *helleri*.

The Santa Catalina snakes, in spite of their dark color, retain evidences of the pre- and postocular light streaks to a greater extent than specimens from the central area. The snakes of the northwestern part of the range quite often have terminal tail rings no wider than the anterior, possibly an effect of a *lutosus* or *nuntius* infusion. However, the light separating rings are not greatly different in shade from the rings themselves; there is not the sharp contrast evident in most *oreganus*.

Intersubspecific Relationships.—It is uncertain whether, today, *cerberus* intergrades with any other *viridis* subspecies; yet its relationship with *helleri*, which is a member of an uninterrupted *viridis* chain, is so close and obvious that it should not be considered a separate species, regardless of its present isolation.

There is a possibility of intergradation between *nuntius*, as found at Valle, Coconino County, and *cerberus* at Crookton and Gleed, Yavapai County, Arizona (see map, Klauber, 1935). A number of the latter show some *nuntius* tendencies, particularly in head scales and narrow posterior tail rings. These localities are only about 35 miles apart, and the intervening territory offers no barrier to rattlesnakes. I should expect intergradation to be eventually demonstrated here, were it not for the fact that there may be an overlap without intergradation at another point. This is in Medicine Valley, just northeast of the San Francisco Peaks, where *nuntius* occurs, while *cerberus* has been taken at a slightly higher elevation along the southern border of the valley, and these specimens do not show intergradient tendencies. Further collecting in this vicinity will be necessary to settle these problems of overlap *vs.* intergradation.*

Of the other subspecies, hitherto considered *oreganus*, *cerberus* seems to be nearest the southern specimens of *helleri*, particularly to the darker individuals found at the higher elevations of the Peninsula ranges of southern California and Baja California, including the Sierra Juárez and Sierra San Pedro Mártir. Surprisingly, the snakes of the Santa Catalina and Rincon

* In the previous discussion of this problem, *loc. cit.* p. 86, read supralabials instead of supraoculars, near the end of the second paragraph.

mountains of Pima County, Arizona, although more distant from California than those from near Prescott, are more like *helleri* in color and head scales.

Range and Locality Records.—*C. v. cerberus* is found only in Arizona and extreme western New Mexico, from the Hualpai Mountains and Cottonwood Cliffs, southeastward to the Santa Catalina, Rincon, Pinaleño, and Blue mountains of southeastern Arizona, and Steeple Rock, New Mexico. The range is not continuous, for this snake is absent from intervening low-lying arid areas, it being essentially a resident of the Transition Zone. Although I had previously reported *cerberus* in Sonora, Mexico (1930a, p. 131), this record is to be judged highly questionable, and is to be suppressed unless verified by additional specimens.

The detailed locality records* available are as follows—ARIZONA: *Apache County*—White Mountains, 5 mi. s. of Greer, Apache Forest (may be Greenlee County); *Coconino County*—Tule Basin (6 mi. sw. of Coleman Lake), Coon Hill (9 mi. s. of Williams), Sunshine Spring (10 mi. s. of Williams), Round Mountain (14 mi. s. of Williams), 2 mi. n. of JD Dam, San Francisco Mountains (type locality), Medicine Valley (ne. side of San Francisco Peaks), Oak Creek, Oak Creek Lodge, Stoneman Lake (6500 ft.), Apache Maid Mountain at 6200 ft., Long Valley, Canyon Creek (26 mi. n. of Young on Holbrook road—may be Navajo County); *Gila County*—2 mi. ne. of Pine, near Payson (elev. 6000 ft.), Tonto Forest (north of Roosevelt Dam), Workman Creek, Workman Creek Trail at 6500 ft. (Mt. Aztec), Sierra Ancha, Salt River (15 mi. n. of McMillanville), bet. Roosevelt Dam and Globe, 6 mi. w. of Globe on US 180; *Graham County*—Pinaleño Mountains near Fort Grant, Mount Graham, Shannon Creek (2 mi. ne. of Arcadia Ranger Station, Pinaleño Mountains); *Greenlee County*—near Hannagan, KP Creek (White Mountains, at 8000 and 8200 ft.), north slope of Rose Peak (Blue Mountains), Eagle Creek at 5000 ft. (20 mi. nw. of Clifton); *Maricopa County*—Cave Creek; *Mohave County*—Hualpai Mountains, 10 mi. e. of Hackberry, near Peach Springs; *Pima County*—Mount Lemmon at least to 9000 ft., (Santa Catalina Mountains), Kellogg Peak (Santa Catalina Mountains), near Spud Rock Ranger Station (Rincon Mountains at 5500, 7000, and 7400 ft.), Manning Camp (Rincon Mountains at 8000 ft.); *Pinal County*—Superior, 2 mi. n. of Pinal Ranch (midway between Superior and Miami), 6 mi. se. of Oracle (n. slope Santa Catalina Mountains); *Yavapai County*—Nelson, Crookton, Gleed, Drake, Hillsdale, Grand View, Kirkland, Skull Valley, foothills bet. Skull Valley and Ramsgate, Ramsgate, Iron Springs, Prescott, near Prescott at 6000 ft., Fort Whipple, Crown King, Senator Mountains (=Senator Mine?, 10 mi. s. of Prescott). NEW MEXICO: *Grant County*—Steeple Rock.

The following localities are to be considered quite doubtful unless verified by additional specimens: Florence, Pinal County; Fort Buchanan, Santa Cruz County; Sonora, Mexico, 20 mi. se. of Sasabe, Pima County, Arizona. The Florence specimen could well have come from the mountains to the

* The locality records are given for this subspecies only, because of its discontinuous range.

northeast, in the vicinity of Superior. Of the Fort Buchanan specimen, only the head is available; it was sent to the U. S. National Museum by Dr. J. B. D. Irwin and comprises one of a troublesome accession of specimens that have led to unwarranted range extensions of other reptile species in the past; for while they are credited to Fort Buchanan, from which place they were sent to the Museum, they were probably collected in southern California, since they include such other non-Arizona forms as *Masticophis lateralis* and *Coluber constrictor mormon*. The Sonora specimens were taken by a collector whose records later proved to be unreliable.

A New Island Subspecies of *Crotalus viridis*

I believe the stunted rattlesnake found on South Coronado Island, Mexico, to be worthy of subspecific recognition and therefore describe it as

Crotalus viridis caliginis* subsp. nov.

Coronado Island Rattlesnake

Plate 5, fig. 2.

1877. *Crotalus adamanteus atrox* Streets, Bull. U. S. Nat. Mus., no. 7, p. 40.
1895. *Crotalus atrox* (part) Van Denburgh, Proc. Calif. Acad. Sci., ser. 2, vol. 5, p. 156.
1895. *Crotalus lucifer* (part) Stejenger, Ann. Rept. U. S. Nat. Mus. for 1893, p. 445.
1896. *Crotalus confluentus* (part) Boulenger, Cat. Snakes, Brit. Mus., vol. 3, p. 576.
1905. *Crotalus oregonus* Van Denburgh, Proc. Calif. Acad. Sci., ser. 3, vol. 4, no. 1, p. 18.
1922. *Crotalus oreganus* (part) Van Denburgh, Occ. Papers Calif. Acad. Sci., no. 10, vol. 2, p. 930.
1929. *Crotalus confluentus oreganus* (part) do Amaral, Bull. Antivenin Inst. Amer., vol. 2, no. 4, p. 92.
1936. *Crotalus viridis oreganus* (part) Klauber, Trans. San Diego Soc. Nat. Hist., vol. 8, no. 20, p. 191.

Type Specimen.—No. 2800 in the collection of L. M. Klauber. Collected June 2, 1930, on South Coronado Island, off the northwest coast of Baja California, Mexico, by E. H. Quayle, and preserved June 10, 1930.

Diagnosis.—A stunted form closely related to, but smaller than, *helleri* of the nearby mainland, and having those features of body proportionality characteristic of stunted races (Klauber, 1938, p. 29) as compared to their larger congeners.

Description of the Type.—An adult male. The fact that it is adult is shown by its possession of an incomplete string of 8 rattles, the oldest of which is no smaller than the proximal ring. The length over-all—measured

* A dweller in the fog. I have Dr. Carl L. Hubbs to thank for this appropriate name for the rattlesnake of this fog-enshrouded island.

before shrinkage in preservative—was 674 mm. and the tail length 52 mm.; ratio of tail to total length .077. The head dimensions were 33 mm. long by 29 mm. wide.

The scale rows are 29–27–25–27 (mid-body) –25–23–22. There are 17 rows at the middle of the tail. The middorsal rows are strongly keeled, the lateral rows less so, and the three lowest rows on each side are practically smooth. The ventral plates number 171; the anal is entire; the subcaudals are 25, only the last being divided. The 8 elements of the rattle string average 11.3 mm. in width; they are substantially equal in size, the greatest difference between any two being 0.2 mm. The supralabials number 16—15, the infralabials 14—15. The first infralabials are undivided, and there are neither submentals nor intergenials. The rostral is higher than wide. Ten scales contact the rostral, there being 4 internasals, and a small extra scale on either side at the rostral-prenasal-supralabial junction. The canthals number 2—3. There is no line of demarcation between the scales in the prefontal and frontal areas; the former number about 23. The minimum scales between the supraoculars number 6+6. The supraoculars are pitted but not sutured. The nasals are divided, the anterior being much the larger. There is but one loreal on either side, the upper preocular contacting the postnasal above it. There are 6 small scales on the right and 5 on the left between the nasals and the pit border. The 2 preoculars on either side are undivided. Nine scales on each side contact the eye. There are 3 to 4 scales between the supralabials and the orbit.

The head is uniform dark-brown above. A preocular light stripe begins at the upper preocular and passes diagonally downward, to end at the angle of the mouth; its anterior section is finely stippled with brown and is less apparent than the posterior, which is almost clear buff. The remnants of what was once a postocular light stripe are to be seen on either side below the canthus. The underside of the head is buff, but the mental, anterior infralabials, and the inner edges of the genials are heavily punctated with gray.

The body pattern comprises some 34 dark-brown dorsal blotches, hexagonal to round anteriorly, but changing into cross-bands toward the tail. The dark dorsal blotches are edged with rows of gray scales, the blotches being separated dorsally by about 1½ light-colored scales. On the sides, in the angles between the main dorsal series of blotches, the scales are darkened, forming an irregular secondary series of blotches of smaller size; below these there is another row of spots that are somewhat darker and more regular than those above. Posteriorly these become confluent with the main dorsal series to form rings. The undersurface is buff, heavily punctated with gray, becoming increasingly dark posteriorly. The tail is crossed by 4 dark-brown rings, separated by narrower light-gray interspaces. The last ring, in characteristic *helleri* fashion, is more than twice as wide as the anterior 3 and is a trifle lighter. The anterior lobe of the rattle matrix is punctated with brown; the posterior lobes are buff. The hemipenes are of characteristic *viridis* form with short spines on the outer shoulders.

Material.—In addition to the type, 30 specimens have been available from the Coronado Islands. Twenty-six specimens are designated as having been collected on South Coronado Island, one on East Coronado, and the other 3 merely from the "Coronado Islands". However, all probably came from South Coronado, for this, the largest island in the group—it is about 1¾ miles long and reaches a peak 672 feet above the ocean—is not only the most southerly, but the most easterly as well (see U. S. Navy Hydrographic Sheet No. 5195). North Coronado, which is also the westernmost of the group, and the second largest, is 2½ miles from South Coronado. The other two islands, currently known as Big Middle and Little Middle, are but rocks lying between the larger pair. I doubt that rattlesnakes have ever been collected on any but South Coronado, and that East Coronado was merely another name applied to that island.

The paratypic series includes the following: California Academy of Sciences 13476, 13583-7, 13603, 63734; LMK 2801-4, 4924-6, 7538-40, 20077-8; Museum of Vertebrate Zoölogy, University of California 5404; San Diego Society of Natural History 11177-8, 13711-5; Stanford University 6681; U. S. National Museum 8564.

Description of Subspecies.—The following description is a summary of the data on 31 specimens, including both the type and paratypes. There are 11 males and 20 females. Fortunately, both juveniles and adults have been available.

This is a snake of normal *viridis* proportions. Like others of the *viridis* subspecies, it is distinguishable from all other rattlesnakes in usually having more than 2 internasals; only 2 out of 31 specimens of *caliginis* have 2 internasals.

The longest available specimen is a male measuring 683 mm.; the longest female is 647 mm. The shortest juvenile measures 220 mm. The ratio of the tail length to the length over-all in the adults averages .079 in the males, and .067 in the females.

Most specimens have 25 scale rows at mid-body, the distribution being 25(23), 26(1), 27(6), 30(1).* The average is 25.58, and the coefficient of variation 4.0 per cent.

The ventrals in the males vary from 167 to 174; the interquartile range is 168.5 to 171.3, the mean 169.90, and the coefficient of variation 1.3 per cent. The ventrals in the females range from 171 to 179. The interquartile range is 173.3 to 176.8, the mean 175.06, and the coefficient of variation 1.5 per cent. The subcaudals in the males vary from 22 to 28, with an interquartile range of 22.7 to 25.4, mean 24.0, and coefficient of variation 8.3 per cent; the females range from 15 to 23, interquartile range 17.6 to 20.1, mean 18.85, and coefficient of variation 10.1 per cent.

The rostral is higher than wide. There are from 2 to 6 internasals; most specimens (23 out of 30) have 4. Two specimens out of 30 have only 2

* High for any *viridis* subspecies; evidently a freak.

internasals and would fail to key out as belonging to a *viridis* subspecies. The canthals are usually 2—2, but there are occasionally 3 on one or both sides. The scales on the snout, anterior to the supraoculars, range from 18 to 30, the mean being 22.8. Since there is no sharp line between these scales and those in the frontal area, observers might differ in counting them. The minimum scales across the space between the supraoculars vary from 3 to 7, most specimens having 4, 5, or 6. Usually there is a single loreal on each side, but sometimes there are 2, and, rarely, none. The prenasal usually contacts the first supralabial, but this contact is prevented by a row of small scales in 3 counts, and in 16 other cases out of 59, there are one or more small scales at the junction of the prenasal, first supralabial, and rostral.

The supralabials range from 12 to 16; most specimens have 14 to 16, the mean being 14.53. The infralabials range from 13 to 18, but most specimens have 15 or 16, the mean being 15.14.

The body blotches vary from 28 to 37; the interquartile range is 31.2 to 34.7, the mean 32.90, and the coefficient of variation 7.9 per cent. The tail rings of the males range from 4 to 6, with a mean of 5.18; and the females from 3 to 5, with a mean of 4.20.

In the juveniles, the head is brown on top, becoming somewhat darker posteriorly. A faint light line crosses the middle of the prefrontal area, and another, better defined, crosses the supraoculars and the frontal area between. A faint middorsal light line usually connects these two cross-lines. On the sides a preocular light stripe begins at the upper preocular, and passes backward and downward to engage the posterior supralabials. A second light band, about 2 scales wide, arises behind the eye and runs back to end at the hinge of the jaw. Otherwise the side of the head is dark-brown, the dark stripe lying between the two light stripes being somewhat darker than the rest. Below, the head is light-gray, except that the mental and first supralabials are stippled with dark-gray.

As the snakes age, the head marks lose much of their definition. The two transverse lines on the crown virtually disappear; and the light streaks on the sides are invaded by gray and brown punctations, so that they become ill-defined and less striking.

The body pattern comprises a series of dark-brown blotches on a gray background. The blotches are quite irregular in shape, but approach hexagons. They are darker on the edges than in the centers. They are about 11 or 12 scale rows wide and 3 scales long (end to end). The gray interspaces are 1 to 1½ scales long. In the lateral angles formed by the light blotch borders, there is a series of secondary brown blotches on each side; and, below these, another darker, better-defined series that engages the edges of the ventrals. Posteriorly, these combine with the main series to form transverse bands. The tail is crossed by similar bands, the last of which is much wider than the others. The ventral scutes are punctated or mottled with gray or brown, especially toward the tail, otherwise the ground color below is buff.

The juvenile body pattern is somewhat brighter and more contrasting, between the light and dark areas, than the adult. Also, the wide terminal tail ring is yellow in the juveniles but becomes brown in the adults.

Of the 20 females, 4 were gravid and contained 2, 3, 3, and 4 eggs.

A hemipenial lobe contains from 36 to 42 short spines and terminates in from 30 to 32 fringes. The organ is typically *viridis* in character.

Intersubspecific Relationships.—C. v. caliginis is obviously derived from *helleri* of the nearby mainland, yet it has evidently been separated from the mainland population for a considerable time. This is to some extent substantiated by the presence on South Island of two other reptiles peculiar to Los Coronados*; *Gerrhonotus multicarinatus nanus*—found on the other three islands as well—and *Pituophis catenifer coronalis* also of South Island.

South Coronado Island is somewhat over 8 miles from the nearest point on the Baja California mainland; and the intervening channel, which is rough and cold, is about 100 feet deep. While rattlesnakes are occasionally found floating in the Pacific a short distance off shore, it is to be doubted whether one could successfully survive this crossing or make a landing upon arrival, for the island is rocky, with precipitous cliffs, and the beaches are few and limited in extent. The winds blow almost continuously from the island toward the mainland. The conditions are quite different from those existing off Florida and Texas, where rattlesnakes (*adamanteus* and *atrox*, respectively) are often found swimming at considerable distances from shore, and there is an unquestioned exchange of population elements between mainland and islands, for the water there is warm and the islands flat, so that landings may be easily made. This difference is substantiated by the number of other islands off Baja California, which, notwithstanding their being only a few miles off shore, are inhabited by reptile forms not occurring on the mainland. Of these, South Todos Santos and San Martín may be cited as examples.

But while the evidence points to a long isolation of *caliginis*, I am unable to find any consistent differences between it and *helleri* in squamation or pattern. The former may be a trifle lighter and grayer—as to ground color—and the latter browner and darker. *C. v. helleri* retains the light head marks of youth at a size at which *caliginis* has lost them. But this is a mere incident of stunting.

This raises the question of how real and important these size differences are. Every evidence points to the fact that they are real, and when consistent in such an isolated form as this, I think they should be recognized just as they have been for many years in the case of birds and mammals. Heretofore it has been said that snakes are different from mammals and birds, in that they do not reach a size limit upon becoming adults. It has, in fact, been believed that snakes grow continuously until death, and that the largest

* Not to be confused with Coronado, a city on the Coronado Peninsula, across the bay from San Diego, California. South Coronado Island is 20 miles south of Coronado, and is on the Mexican side of the international boundary.

specimens are merely the oldest. But with the acquisition of much larger series in collections, and the observations on specimens kept alive for long periods in zoos, we now know that this is true only to a minor degree. Reptiles certainly do not attain a growth limit as suddenly as mammals; they may, indeed, continue to grow slowly throughout life. But in any case, this adult growth is minor in extent, so that the longest snakes of a subspecies are not necessarily the oldest, but are merely variants of the same character as tall men.

No *caliginis*, regardless of age or intrasubspecific variation, would ever grow to the size of an average adult mainland *helleri*. Six specimens out of 31 *caliginis* exceed 600 mm. and none reaches 700. In *helleri* 1100-mm. specimens are not at all exceptional, and considerably longer ones have been recorded. If we were to compare, visually, a 650-mm. *caliginis* with a 1100-mm. *helleri*, we would find the difference far more striking than is indicated by these figures, for the *helleri* would have 5 times the bulk of the smaller snake.

Further evidence of the stunted nature of *caliginis* is to be found in the sizes of the gravid females among the paratypes. These have lengths of 528, 547, 560, and 647 mm. Gravidity does not generally appear in *helleri* until a considerably larger size is reached; the smallest gravid specimen I have seen in a very much larger series was 596 mm. in length.

Another evidence of the stunted character of *caliginis* is head proportionality, which I have discussed elsewhere (1938, p. 29). Another is the size of the rattle when parallelism is reached; this is at a width of about 10 mm. in female *caliginis*, and 11 mm. in the males. The corresponding dimensions, in normal mainland *helleri*, are about 15 mm. in females and 17 in males. The average widths of the first 6 rattles in an unbroken string in *caliginis* are 6.3, 7.2, 8.2, 8.9, 9.5, 9.9,* whereas in *helleri* they average 6.6, 8.2, 9.7, 11.2, 12.5, 13.3 mm. It will be noted that there is an increasing proportional divergence with age, the *helleri* rattle being only 5 per cent larger at the button stage, but is 34 per cent larger at the sixth-rattle stage.

I have examined 22 rattlesnakes from Santa Catalina Island, Los Angeles County, California. They are somewhat larger and darker than the snakes of South Coronado, and I therefore prefer to consider them *helleri*. They have typical *helleri* tail rings. The rattle dimensions, however, are more like *oreganus* than *helleri*.

Food Habits.—*C. v. caliginis* differs from the mainland *helleri* in feeding primarily on lizards, and this in spite of the fact that South Coronado Island is well populated with rodents that an adult *caliginis* could cope with quite successfully. I am told by L. M. Huey that the Coronado Island white-footed mouse (*Peromyscus maniculatus assimilis*) is relatively abundant on the island. *Helleri*, on the mainland, feeds primarily on mammals, although lizards comprise an important part of the diet of the juveniles. But *caliginis*

* Sexual dimorphism does not become important until the seventh or eighth rattle.

does not modify its propensity for lizards even when it has reached a size adequate to eat mice. Of the 20 specimens examined that contained recognizable food remains, only one had mammal hair, and this is the more remarkable since hair is recognizable until the feces are voided, which is not always true of lizard scales. The other 19 contained lizard remains; 6 could be recognized as *Gerrhonotus multicarinatus nanus*, 3 as *Eumeces skiltonianus*, and one as *Uta stansburiana hesperis*, the other 9 being too far digested to be identified. A large alligator lizard is a full meal for an adult *caliginis*. Mr. Huey advances the plausible theory that the rattlesnakes may be forced by the climate—which is cold and foggy—to be largely diurnal, as are the lizards, while the mice are nocturnal. The mice have their daytime refuges in rock crevices and cactus, and are probably not so easy for the snakes to catch as are mice on the mainland, where the rattlers may seek their nocturnal prey down ground holes in the daytime, during those seasons in which the snakes themselves are not nocturnal.

A NEW ISLAND SUBSPECIES OF *Crotalus mitchellii*

For years I had heard, from ornithologists and others visiting the islands of the Gulf of California, that rattlesnakes were quite common on one island from which no museum had secured specimens, this being "San Luis". In 1946 arrangements were made with Messrs. Lewis W. Walker and Charles H. Lowe, Jr., to visit this island, Mr. Lowe, particularly, having the primary purpose of securing rattlesnakes. In this, the expedition was quite successful, many interesting herpetological specimens, including rattlesnakes, being collected. However, the rattlesnakes do not occur on the island designated as San Luis on the maps, although they are on one of the islands that have been called the San Luis group*, which lies in the Gulf of California, just off the Baja California coast, at Lat. 30° N. The island known to the Mexican fishermen as San Luis is off Willard Point (see U. S. Navy Hydrographic Sheet No. 0619, 53d edition) in San Luis Gonzaga Bay; the one named San Luis on the maps is farther off-shore; it is the largest island of the group and is called La Encantada Grande by the fishermen. Proceeding along the archipelago, in a northwesterly direction from La Encantada Grande, the other islands, according to Mr. Lowe and other recent visitors, are known to the Mexicans by the following names: Pomo, Islote, Cholludo, Coloradito, El Muerto, and Huérfanito. El Muerto,† although much smaller than La Encantada, is next in size; and this is the island where the rattlesnakes occur. It lies about 3 miles from the nearest mainland, east of El Mármol. It is probably the island referred to in the previous accounts, since rattlers have not been discovered on any of the other islands by recent expeditions and they are quite plentiful on El Muerto. Subsequent to the

* The fishermen usually refer to this group as Las Islas Encantadas, while some maps call it the San Luis and others the Salvatierra group.

† El Muerto is not designated by this name on any map known to me. When named at all, it is called Miramar, Link, or, to add to the confusion, La Encantada. The other islands of the group are also assigned several alternative names, but I shall not compound the perplexity by listing them.

Walker-Lowe expedition, Joseph R. Slevin and Wallace F. Wood visited there in May, 1947, and secured specimens for the California Academy of Sciences.

The El Muerto rattlesnake proves to be a dwarfed race of *Crotalus mitchellii*. I deem it worthy of subspecific recognition and describe it as

Crotalus mitchellii muertensis subsp. nov.

EL MUERTO ISLAND SPECKLED RATTLESNAKE

Plate 6, fig. 1.

Type Specimen.—No. 37447 in the collection of L. M. Klauber. Collected June 6 or 7, 1946, on El Muerto Island, Gulf of California, Mexico, by Charles H. Lowe, Jr., and preserved June 22, 1946.

Diagnosis.—A dwarfed island race, allied to *C. m. pyrrhus* of the mainland, from which it differs in its small size and in having 24 or fewer scale rows more often than 25, while the contrary is true of *pyrrhus;* also in having a higher average number of body blotches. In adult head proportions, *muertensis* resembles *C. m. pyrrhus* rather than *C. m. mitchellii*. It differs from all other rattlesnakes, except *pyrrhus* and *m. mitchellii*, in usually having the rostral separated from the prenasal by a row of granules.

Description of the Type.—An adult male. The length over-all, as measured before shrinkage in preservative, was 633 mm. and the tail length 42 mm., the ratio being .0663. The head (also measured in life) was 26.9 mm. long, being contained 23.5 times in the length over-all.

The scale rows number 27–23–19, with 14 around the middle of the tail; all rows are keeled, except the lowest lateral row, which is also the largest. The ventrals number 177 and the subcaudals 22, of which the last 2 are divided. The anal is entire. There are 17—17 supralabials and 16—16 infralabials. The first infralabials are undivided and there are neither intergenials nor submentals. The rostral is triangular, and of equal height and width. As is usual in the *mitchellii* subspecies, the scales on the snout are much broken up so that few can be assigned the customary names with assurance. The rostral is separated from the prenasal on both sides by rows of granules; also, the small scales anterior to the pit are carried forward to the rostral so that the anterior nasal is separated from the supralabials. The area usually occupied by the upper preoculars in most rattlesnakes contains 4 scales on each side, indicating that this scale has been split both horizontally and vertically. There are 3 to 4 scale rows on either side between the supralabials and the orbit. There are about 26 small scales in the internasal-prefontal area; the minimum scales across the frontal area number 6+6. The supraoculars are by far the largest scales on the head; they are indented by a crease that may be the beginning of a suture on the right, and a pit reminiscent of *stephensi* on the left. The mental is triangular. The first infralabials meet on the median line; altogether, 3 infralabials contact the genials on either side.

The head is gray above, somewhat darkened with irregular brown blotches anteriorly. A few of the posterior scales on the head contain black dots. There is some evidence of a dark-gray postocular stripe, with a lighter stripe below, but these are by no means definite. The mental and infralabials are punctated with gray, but otherwise the undersurface of the head is cream.

The ground color of the dorsum is light-pink, marked by 37 gray-brown blotches that become cross-rings posteriorly. The edges of the blotches are not well defined. The blotches have brown centers and gray edges; the brown areas are speckled with dark-brown or black dots, and the gray with darker-gray. Anteriorly, a series of secondary lateral blotches is in evidence; posteriorly these spots merge with the dorsal series to form transverse bars. The sides are much suffused and speckled with gray. The ventral surface is cream anteriorly and buff toward the tail, the outer edges of the ventrals being often stippled with gray, especially posteriorly. The tail is gray, with two gray-brown rings, followed by a pair of irregular black marks. The rattle matrix is mottled with black and gray.

Material.—In addition to the type, 18 specimens have been available, all from El Muerto Island. The paratypes are as follows: LMK 37442-4, 37446-49, 38040; and CAS 81354-63.

Description of Subspecies.—The following description is based on 19 specimens, the type and paratypes taken together. There are 9 males and 10 females. All are adults or adolescents, no juveniles being available.

This is a rattlesnake of the usual *mitchellii* form, characterized by the interposition of a row of small scales between the rostral and prenasal, and the extreme subdivision of the other head scales, those on the crown being convex.

The longest individual is a male measuring 637 mm.; the longest female is 534 mm. Four males out of 9 are above 600 mm., and 3 females out of 10 over 500 mm. The shortest snake is a female measuring 431 mm. The ratio of the tail length to the length over-all averages .067 in the adult males, and .053 in the females.

The majority of specimens have 23 scale rows at mid-body, the distribution being as follows: 11 or 58 per cent have 23; and 8 or 42 per cent have 25. The average is 23.8. The head-length equation is approximately $H=.0336L+6.5$, where H is the head length and L the length over-all, both expressed in millimeters.

The ventrals of the males range from 175 to 184 with a mean of 179.7; and in the females from 174 to 181 with a mean of 178.3. It is to be doubted whether larger series would validate this superiority of the males, for in all other rattlesnake subspecies of which adequate series are available the females average from 1 to 7 ventrals higher than the males. It is to be noted that the sexual dimorphism is lower in *mitchellii* than in other species and subspecies. Returning to *muertensis,* the subcaudals in the males vary

from 21 to 24 with an average of 22.9; and in the females from 16 to 18 with a mean of 17.4.

The rostral is about as high as wide, being slightly higher in some individuals and wider in others. All specimens except two have the rostral separated from the prenasals by small scales or granules in the manner so characteristic of all *mitchellii* subspecies except *stephensi;* in the exceptional specimens the contact is complete on one side. The separation of the prenasal from the supralabials, by the extension to the rostral of the small scales anterior to the pit, is not so universal, for at least a partial contact is made in 17 out of 38 cases. The crescent-shaped postnasal, characteristic of all rattlesnakes, is sometimes divided into a small upper and a larger lower part.

The loreal-preocular area is usually occupied by a number of small scales or granules, so that it is no longer possible to identify the large upper preocular, or the single or paired loreals characteristic of most rattlesnakes; where homologues can be recognized, it is evident that the upper preocular has usually been divided both vertically and horizontally. The narrow crescent-shaped lower preocular, that comprises the upper border of the pit in most species of *Crotalus,* is sometimes in evidence, but is often broken up into smaller scales. In all except one specimen out of 19 there are blemishes on the supraoculars. Usually these take the form of pits or small sutures at the outer edges. In only 2 specimens out of 19 are these as prominent as is normal in *stephensi;* nevertheless they are more prevalent in *muertensis* than in *m. mitchellii* or *pyrrhus.*

The scales in the internasal-prefrontal area are so broken up that they cannot be counted with accuracy. Most of them are decidedly convex. The minimum scales between the supraoculars vary from 4 to 8, with 5, 6, or 7 predominating; the average is 5.7.

The supralabials range from 14 to 18, most specimens having 14 to 17; the mean is 15.9. The last supralabial is about as long as the others. The infralabials number 14 to 19, most specimens having 15 to 18, with a mean of 16.5. The mental is triangular and is often sharply pointed posteriorly. The first infralabials meet on the median line and are followed by a single pair of enlarged genials. No first infralabials are divided, and no specimen has submentals or intergenials. The supralabials are usually smaller than the row of scales above them. The considerable enlargement of the last supralabial that characterizes most *m. mitchellii* is not evident.

The body blotches vary from 32 to 39 with a mean of 35.7. The tail rings in the males vary from 3 to 6, with a mean of 4.3; and the females from 2 to 5, with a mean of 3.3.

C. m. muertensis gives a general impression of grayness, the color being applied to a considerable extent in the form of small spots or punctations characteristic of the *mitchellii* subspecies, and with the indefiniteness of blotch outlines evident in all the subspecies except *stephensi.*

The head is usually gray above, occasionally with a pinkish tinge, and with some evidences of irregular brown spotting. There are always some

black dots scattered over the crown. On the sides there usually remain some traces of a postocular dark stripe bordered with lighter streaks above and below. The mental, the infralabials, and the fronts of the genials are speckled with gray, otherwise the underside of the head is cream, although there may be a few gray dots scattered about.

The dorsal pattern comprises a series of indefinitely outlined blotches, tending toward hexagons anteriorly and toward cross-bands posteriorly, where they become confluent with the lateral series and are somewhat more contrasting with the ground color. The blotches usually have brown centers and gray edges, but both areas are often speckled with dark-gray, dark-brown, or black dots. Dorsally, between blotches, there are usually pinkish spaces, which are sometimes moderately clear of punctations. Laterally there is a gray suffusion, so that the secondary lateral series is often ill-defined, especially anteriorly. The ground color of the lowest rows of lateral scales is cream or pink, and the punctations here become darker, being often black. The undersurfaces of the body vary from cream to buff, always becoming darker posteriorly, and with considerable dark mottling or stippling, particularly at the edges of the ventrals.

The tail is gray, with an anterior ring or two of brown or dark-gray, stippled with black, and several posterior black rings that are generally irregular in shape. The rattle matrix is mottled gray and black. The rattle widths in the adults, after parallelism is attained, vary from about 10 to 11 mm. in the males, and 8.5 to 9.5 mm. in the females. I have seen only two buttons in *muertensis;* one measured 6.1 mm. in width, the other 5.5 mm.

Intersubspecific Relationships.—That *muertensis* is a dwarfed form is indicated in four ways. First, a sample of 19 specimens collected by two parties failed to locate any individual longer than 637 mm. (25 inches). A similar collection on the mainland would certainly have resulted in larger specimens being found. For comparative purposes I give the record lengths known to me of the three mainland subspecies: *mitchellii,* 939 mm.; *pyrrhus* 1295 mm.; and *stephensi,* 943 mm. It should be recalled that a snake 50 per cent longer than another is more than 3 times as bulky.

Second, we have the evidence of the gravid females, of which 6 *muertensis* are at hand, measuring respectively 431, 456, 482, 489, 515, and 533 mm. The smallest gravid *mitchellii* I have seen measured 797 mm., the smallest *pyrrhus,* 786; and the smallest *stephensi,* 674 mm., and this in much larger series.

Then there are the rattles, which reach parallelism in the male *muertensis* at a width of about 10 to 11 mm., and in the females at 8.5 to 9.5 mm. In *mitchellii,* which is noted for its large rattles, proportionate to the size of the snake, the corresponding figures are about 15 mm. for the males and 14 mm. for the females; and in *pyrrhus* about 14 and 13 mm.

Finally, the head proportions indicate stunting; for while the adult head-to-body ratio in *muertensis* is about the same as that of *pyrrhus,* at

similar body lengths the *muertensis* head is smaller than that of *pyrrhus*, as is always true of dwarfed races for reasons that I have discussed elsewhere (1938a, p. 29). For example, an average *muertensis* head in a 600-mm. snake would have a length of 26 8 mm., while a *pyrrhus* of this size would have a head measuring about 29.2 mm.

As might be expected from geographic considerations, *muertensis* more nearly resembles *pyrrhus* than *stephensi* or *mitchellii* in most characters. Data on the previously recognized subspecies will be found in Klauber, 1936a.

Although superficially like *mitchellii* in color and pattern, *muertensis* trends strongly toward *pyrrhus* in other important features. It resembles that subspecies in adult head and tail proportions, *mitchellii* having a relatively smaller head and longer tail. The spines in the cleft of the hemipenes in *muertensis* are like those of *pyrrhus*, in that they do not approach as close to the sulcus as they do in *mitchellii*. *C. m. muertensis* shows no particular likeness to *stephensi*, except that the frequency of supraocular pits or sutures characteristic of *stephensi* is much higher in the island form than in mainland *pyrrhus*. But *muertensis* is sharply differentiated from *stephensi* in the almost universal separation of the rostral from the prenasals. The *muertensis* pattern, also, is much more like that of *pyrrhus* than *stephensi*, in that the blotch outlines are vague.

As to the particular geographical phase of *pyrrhus* that *muertensis* resembles, it apparently is more closely allied to the Arizona than to California or Baja California snakes, judging from the frequency of 23 as opposed to 25 scale rows, for the lower number is more prevalent in the Arizona snakes than in those from California. On the other hand, *muertensis* is high in ventral scale counts, and in this respect more nearly approaches the California snakes—which is all the more notable since stunted forms usually have a tendency toward fewer ventrals. The average number of body blotches in *muertensis* somewhat exceeds the mean in either California or Arizona specimens. Another criterion in which *muertensis* is closer to the Arizona *pyrrhus* than to the California stocks—particularly those that come from south of the Riverside-San Bernardino county line—is in the splitting of the preoculars both horizontally and vertically. This occurs in almost every *muertensis* and it is characteristic of the Arizona *pyrrhus* as well. The San Diego County snakes often have these scales entire, or split only horizontally or vertically, rather than in both directions.

The rattlesnake species *mitchellii* occurs off Baja California on islands other than El Muerto, but on none of the other islands do specimens show any tendency toward *muertensis;* all resemble, as might be expected, the nearest mainland forms. Those from Ceralvo, Espíritu Santo, San José, and Santa Margarita islands are to be classified as *m. mitchellii*, since they have the head and tail proportions of *mitchellii*. It is interesting to observe that, although only a single specimen representing each island has been available from Ceralvo, San José, and Santa Margarita, and 3 from Espíritu Santo, yet every one of these islands has produced a larger snake than the largest of

the 19 specimens from El Muerto, another proof of the relatively small size of *muertensis*.*

Beside El Muerto, Angel de la Guarda Island is the only other island off *pyrrhus* territory known to be inhabited by a *mitchellii* subspecies. The snakes of this island are clearly allied to *pyrrhus* and are very large, which is unusual for island inhabitants; they may, in fact, prove to be larger than any mainland *pyrrhus* and are thus quite different from *muertensis*.

Field Notes.—The following field notes were compiled by Charles H. Lowe, Jr., when he collected the first specimens of *muertensis* on June 6 and 7, 1946:

"Of the 9 specimens taken, 5 were collected during evening twilight; 3 were crawling when found and 2 coiled. The other 4 specimens were found in the morning, from shortly after sunrise until as late as 7:30 A.M.; all were coiled among rocks. This snake seems, therefore, to be crepuscular, which may be correlated in part with its lizard feeding habits.

"It is interesting to note that all 9 specimens, when found, were within approximately 20 feet (usually less) of safe retreats in rocky crevices or holes. The intense daytime heat and the lack of shading vegetation makes it imperative that they stay near satisfactory shelters from the sun. An indication of the intense daytime heat in the open sunlight is seen in the fact that the two lizards inhabiting the island, *Uta mearnsi* and *Uta stansburiana*, when observed sitting on rocks after 8:30 to 9:30 A.M., were always in the shade, never sunning themselves.

"The night of June 6-7, 1946, was warm. The air temperature that night on El Muerto probably dropped but little, if any, under 80° F., as indicated by the 9:30 P.M. (June 6) temperature of 86° F., and the 4:30 A.M. (June 7) temperature of 80° F. The rattlers, observed coiled on rocks and apparently asleep early in the morning just as the rising sun was reaching them, appeared to have been there for some time, awaiting the sun to warm them. Perhaps they had remained coiled in the same place since the previous evening.

"All 9 rattlesnakes showed vicious dispositions. They rattled continuously from the moment they saw or heard someone approaching, and for a considerable time after being sacked. When touched, they thrashed their bodies about wildly. One snake bit the dirt three or four times when held down by the neck. Another thrashed so violently and suddenly after being picked up by the neck that it threw itself out of my grasp and onto the ground. Their actions upon the approach of an intruder leads one to believe that they have some important enemy; perhaps a bird of prey. Ospreys and duck hawks live on the island.

"The rattlesnakes were found from the beaches to the ridge of the island, some 626 feet in elevation. Likewise, at least one of the two species

* The Santa Margarita specimen was destroyed in the San Francisco fire but the length is of record.

of lizards, both of which the rattlers somewhat greedily ate, is found on all parts of the island where the rattlers were taken. *Uta stansburiana* is restricted to the beach area and *Uta mearnsi* to the sides and tops of the island, not being found on the beach rocks.

"A recently dropped sample of snake feces, found near one of the rattlesnakes taken on the beach, contained rodent hair. A few other indications that mice inhabit the island were found. None could be trapped by using peanut butter as bait. There were indications that one rodent on the island is a pocket mouse. The following incidents, on June 7th, indicate that the snakes feed upon the two species of lizards inhabiting the island, when possible:

> "At 5:05 A.M., a *Uta mearnsi* of medium size was shot and placed (dead) in a white snake-sack. At 5:30 a medium-sized *Crotalus* was placed in the same sack with the *Uta*, and the dead *Uta* was eaten sometime that morning before 9:30.
>
> "At 5:25 P.M., a large *Crotalus* was caught on the southeastern beach. Five minutes later an adult male *Uta stansburiana* was shot a few feet from where the rattler was found. At 6:15 P.M. the *Uta*, having been dead for ¾ hour, was placed in the sack with the rattlesnake, whereupon the rattler swallowed the lizard in the next 10 minutes.
>
> "The rattlesnakes are hard to see, although the rocks on which they are found are multicolored."

J. R. Slevin reported that he got one rattler on a boulder-strewn beach as the snake was moving inland to escape the tide. Two specimens contained mice (*Peromyscus*).

Upon examining the snakes comprising the type series, I found mammal hair in 6 and lizard scales in 4 others. Evidently *muertensis* welcomes either food and does not strongly prefer lizards, as does *caliginis* on South Coronado Island.

THE BLACK-TAILED RATTLESNAKE OF SAN ESTÉBAN ISLAND

Schmidt (1922, p. 697) was the first to mention the presence of *Crotalus molossus* on San Estéban Island in the Gulf of California. From the single specimen then available he pointed out some of the differences as compared to the mainland snakes. Subsequently, when I examined this specimen, I thought that some of its peculiarities might be due to its poor state of preservation, which later proved to be the case when a live specimen was secured in 1937, through the courtesy of Capt. G. Allan Hancock. Evidently these snakes are not common on the island, as several other expeditions, asked to be especially on the lookout for them, have failed to find any.

Some 10 years ago (1938b, p. 193) I expressed the opinion that the subspecific recognition of this snake was not justified. However, since then I have revised my opinions with regard to island subspecies, the taxonomic

importance of stunting in snakes, and the practical benefits accruing from the nomenclatorial segregation of island races. For these reasons I have decided to name the San Estéban black-tail

Crotalus molossus estebanensis subsp. nov.

San Estéban Island Rattlesnake

Plate 6, fig. 2.

1922. *Crotalus molossus* (part) Schmidt, Bull. Amer. Mus. Nat. Hist. vol. 46, art. 11, p. 697.

1936. *Crotalus molossus molossus* (part) Klauber, Trans. San Diego Soc. Nat. Hist., vol. 8, no. 20, p. 249.

Type Specimen.—No. 26792 in the collection of L. M. Klauber. Collected on San Estéban Island, Gulf of California, Mexico, by an expedition under Capt. G. Allan Hancock, and preserved April 17, 1937. Paratype USNM 64586, April 18, 1911, C. H. Townsend, collector.

Diagnosis.—A stunted island *molossus,* related to the nearby mainland form, from which it differs in pattern and in body proportions. The blotches are lighter, smaller, and more numerous than in typical *molossus;* it also lacks the darkening of the internasal-prefrontal area.

Description of the Types.—The holotype is an adult female. The fact that it is adult is shown by the presence of eggs, and its having a broken string of 5 rattles that are uniform in size. As measured before setting in preservative, the length over-all was 737 mm., the tail length 41 mm., and the head 33.7 mm. The rattles vary from 9.6 to 9.8 mm. in width.

The scale rows are 33–27–21, with 13 at the middle of the tail. The dorsal rows are keeled; the 3 lowest lateral rows are smooth; the row adjacent to the ventrals is larger than any others of the dorsal series. The ventrals number 192; the anal is entire; there are 22 subcaudals, of which the first and last 2 are divided. The scales in the prefrontal area total 6, comprising 2 long slim internasals, each of which is almost broken to produce an internasal and a canthal; a pair of small scales between the internasals; and a pair of large prefrontals. The scales between the supraoculars are quite small, the minimum bridge being 5, followed by 6. The supraoculars are undivided. The rostral is slightly wider than high. The prenasal is almost separated from the first supralabial by the small scales anterior to the pit on the right, and is separated on the left; these small scales number 8 on each side. There are 2 loreal scales on each side, and 2 extra scales in the subcanthal area; these are difficult to classify in *molossus.* There are 2 preoculars on either side; and 5 post- and suboculars on the right and 7 on the left. There are 3 to 4 rows between the supralabials and the orbit, these counts including the suboculars. The supralabials number 18—18 and the infralabials 16—17. The first infralabials are undivided and there are no intergenials or submentals. Three infralabials contact the mentals on either side.

The head is unicolor olive-brown on top, although some evidences remain of darker blotches. On the sides there is faint evidence of an ocular dark stripe passing backward above the angle of the mouth. Below this there is an almost obsolete light streak. The supralabials are punctated with brown anteriorly, but become clearer toward the angle of the mouth. The mental and infralabials are also punctated with brown, although the 6th to 8th on each side are almost clear; the undersurface of the head is otherwise buff.

The dorsal pattern comprises 41 olive-brown blotches with grayish interspaces.* The blotches are of the usual *molossus* character, that is, they are open on the sides, are bounded by unicolor scales, and often have a few light-colored scales at their centers. The first 8 blotches are closed by light borders laterally; but those that follow are open and are extended laterally, in the form of single rows of zig-zag brown scales, to the ventrum. Posteriorly, the light scales bordering the dorsal blotches become darker, while the blotches themselves become lighter, until the contrast has declined to such an extent that the posterior 10 blotches are virtually obsolete. They can only be counted by recourse to their lateral extensions, which remain in evidence. The belly is cream-colored, with brown punctations on the scutes adjacent to the lateral blotch-extensions. The punctations on the lower surface increase posteriorly. The tail marks comprise 6 rings, brown anteriorly, but changing to dark-brown, and then to black at the rattle. The last 3 interspaces, which are grayish, are evident only on the sides. Below, the tail is gray anteriorly, but otherwise black. The rattle matrix is black.

The paratype is a juvenile male in a rather poor state of preservation. The length over-all is 466 mm., the tail length 35 mm., and the head 23½ mm. The scale rows are 31–27–21, the ventrals 189, and the subcaudals 26. The rostral is wider than high. The supralabials number 17—19, and the infralabials 17—16. The scales in the crown comprise 2 internasals and 2 prefrontals. The minimum scales between the supraoculars number 4—4. The group of small scales anterior to the pit is carried forward to the rostral, thus preventing a contact between the prenasal and first supralabial. There are 2 preoculars and 2 loreals on either side. The upper preoculars are undivided. There are from 2 to 4 rows of scales between the labials and orbit.

The general color is grayish. The dorsal blotches, which are olive-gray, are too faint to be counted with accuracy, especially posteriorly; this may, in part, be due to the condition of the specimen. The tail rings are faintly in evidence through the lightening of the interspaces; they are almost black.

Intersubspecific Relationships.—San Estéban Island lies in the middle of the Gulf of California in Lat. 28° 40′ N. It is a barren and rocky island about 3½ miles in diameter. The nearest land is Tiburón Island 6½ miles to the northeast, and San Lorenzo Island 12½ miles to the west. *Crotalus atrox* is found on Tiburón and *C. r. ruber* on San Lorenzo; so far as is known, *C. molossus* occurs on neither. Besides this new rattlesnake, San Estéban is

* In life these colors at mid-body, using Ridgway's Standards, 1912, were Brownish Olive and Reed Yellow.

known to harbor 5 other reptiles, 2 of which, *Cnemidophorus estebanensis* and *Sauromalus varius,* have differentiated sufficiently from their nearest relatives elsewhere to be deemed valid species.

As might be expected, *Crotalus m. estebanensis* is much nearer *C. m. molossus* than *C. m. nigrescens;* it has the lighter color, higher number of ventral scales, and lateral blotch extensions that characterize the former subspecies.

From *molossus molossus* the differences are only matters of degree, and some may not be substantiated when more specimens of *estebanensis* become available. It is stunted and has the morphological differences characteristic of dwarf races. Thus the head of the adult type is somewhat shorter than that of a *molossus* of similar size; and the rattle has reached parallelism at a width considerably less than that noted in adult females of *molossus* from Sonora and Arizona, the relative figures being about 9.7 and 14.5 mm. Furthermore, the rattles are peculiarly compressed both longitudinally and transversely, making them quite different in shape from the usual *molossus* rattle. This is another characteristic of some dwarfed forms.

In pattern, the new form differs from *molossus* of the mainland in having smaller, lighter, and more numerous dorsal blotches. Lowland *molossus* are less brightly patterned, with less color contrast between the dorsal blotches and the interspaces, than those from the higher elevations, especially in the mountains of southern Arizona; but the type of *estebanensis* is particularly light-colored, and with the dorsal blotches quite obsolete posteriorly. Whether the same condition originally existed in the paratype cannot be determined because of its condition. Best of all the characters, from the standpoint of a key, is the high number of dorsal blotches. The type has 41; out of 144 specimens of *m. molossus* available, only one specimen reaches this number. and only 3 have more than 38, the mean being 31.3. A further difference in the type of *estebanensis* is the absence of a dark-brown patch on the crown of the head in the internasal-prefrontal section. This is evident, and even prominent, in most mainland *molossus.*

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SUMMARY

In a resurvey of the widespread Pacific rattlesnake, *Crotalus viridis oreganus*, geographical differences are found to warrant recognizing two additional subspecies, one involving the southern California and northern Baja California population, the other that in Arizona. For these, names long in synonymy are now revived, the California subspecies to be known as *Crotalus viridis helleri* Meek, 1905; and the Arizona form as *C. v. cerberus* (Coues), 1875. Territorial boundaries and subspecific differences are discussed.

Three new rattlesnake subspecies are described, dwarfing being considered an important justification for the recognition of three island subspecies: These are *Crotalus viridis caliginis* of South Coronado Island, off the northwest coast of Baja California, Mexico; *Crotalus mitchellii muertensis* of El Muerto Island, off Baja California near the head of the Gulf of California, Mexico; and *Crotalus molossus estebanensis* from San Estéban Island in the central Gulf of California.

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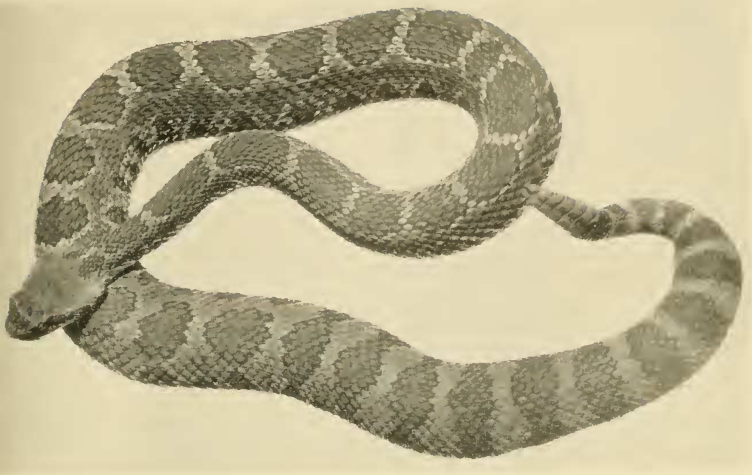

Fig. 1. *Crotalus viridis oreganus* Northern Pacific Rattlesnake
Young adult male from near Wenatchee, Chelan County, Washington.

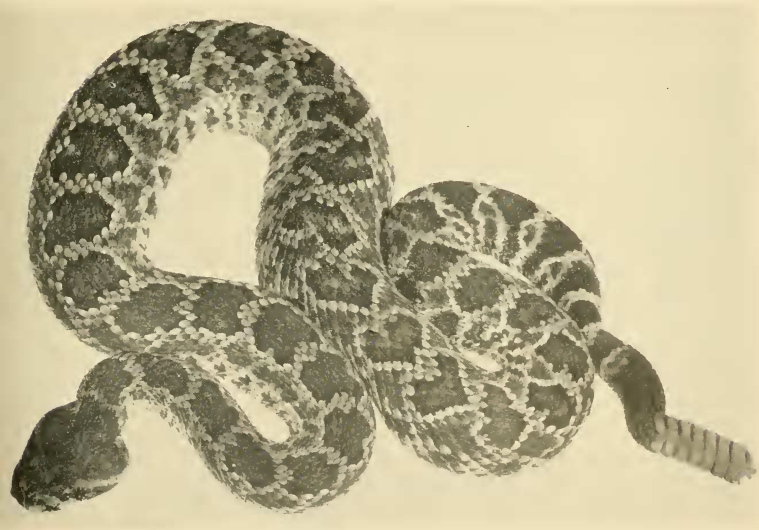

Fig. 2. *Crotalus viridis helleri* Southern Pacific Rattlesnake
Adult male from Rancho Santa Fe, San Diego County, California

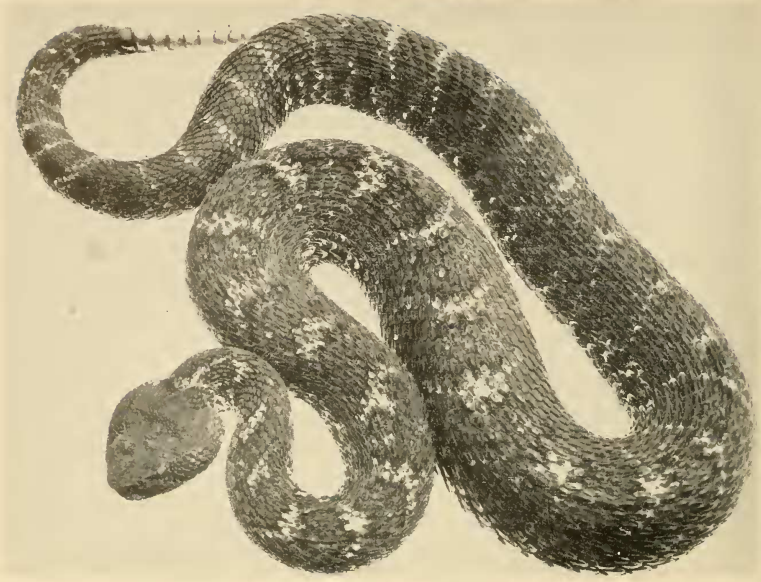

Fig. 1. *Crotalus viridis cerberus* Arizona Black Rattlesnake.
Adult male from Hillside, Yavapai County, Arizona

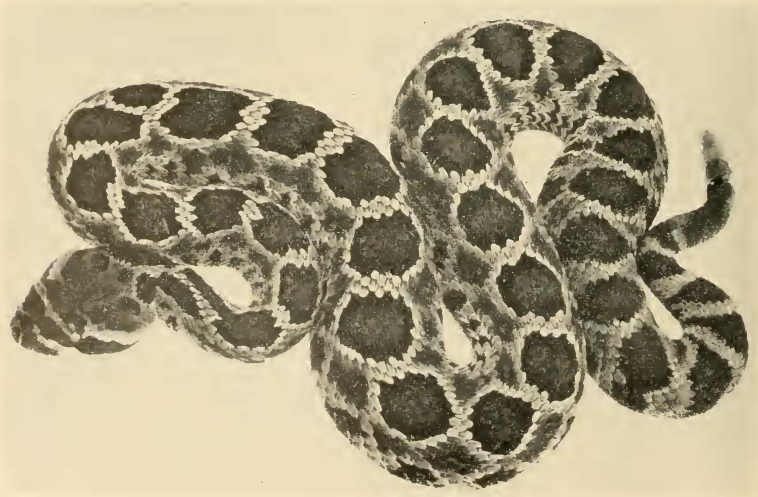

Fig. 2. *Crotalus viridis caliginis* Coronado Island Rattlesnake.
Young male from South Coronado Island, Pacific Coast of Baja California, Mexico.

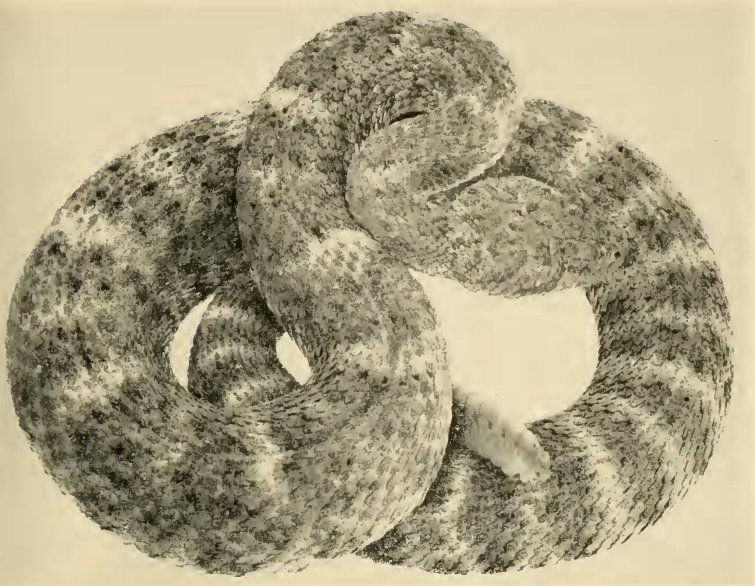

Fig. 1. *Crotalus mitchellii muertensis* El Muerto Island Speckled Rattlesnake.
Adult male from El Muerto Island, Gulf of California, Mexico.

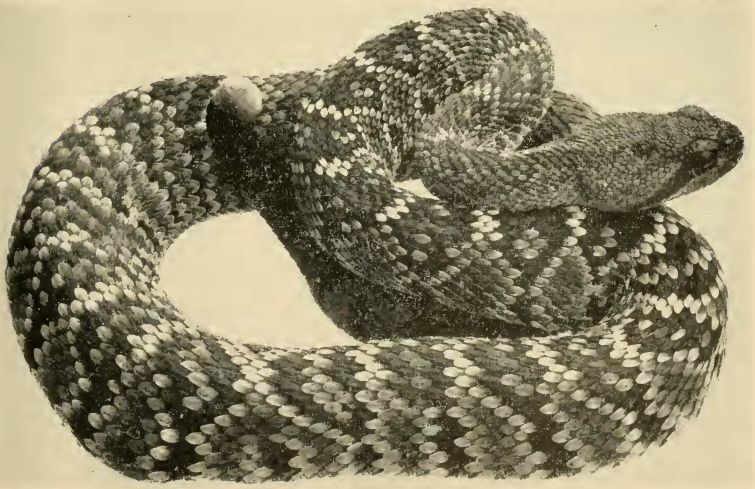

Fig. 2. *Crotalus molossus estebanensis* San Estéban Island Black-tailed Rattlesnake.
Adult female (type specimen) from San Estéban Island, Gulf of California, Mexico.